A HEMISPHERIC STUDY OF WEATHER TYPES

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Submitted in partial fulfillment of
the requirements for the degree of

MASTER OF SCIENCE
IN
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ABSTRACT

Existing Northern Hemisphere weather types are modified, where necessary, and new types developed to give complete coverage of both the surface and 500-mb flow. A new classification system is devised. The possible use of these types on a hemispheric basis is explored, and recommendations for future study are made.

It is to be noted that, in every sense, this paper represents a joint effort by the authors. The authors are deeply indebted to Professor W. D. Duthie, Chairman, Department of Aerology, U. S. Naval Postgraduate School, for his invaluable aid in the preparation of this manuscript.

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1. Introduction

Weather forecasts are predictions of meteorological elements in greater detail than those supplied by climatology. In those areas of the world where the weather pattern is unchanging from day to day (within seasons) it becomes a more or less simple matter to predict future weather on the basis of climatic normals. In most regions of the world, however, meteorological elements are variable to such a degree that climatological averages, while useful, are totally inadequate to provide a fairly accurate picture of next week's weather.

Weather forecasts can be prepared and issued for any period in advance of the present. The shortest forecasts may be made for the duration of an aircraft flight, while operational planning may require a forecast for a much longer period. Generally speaking, forecasts for a period up to 48 hours in advance of the present are considered "short range" forecasts, while those of any longer period are termed "long range" forecasts.

Up to the present, the various schools of long range forecasting have employed four principal techniques, singly or in combination. These can be broadly classified as statistical, analog and/or typing, evolutionary, and numerical. [11]

The object of this research is to broaden the weather typing technique so as to further its use as a tool in long range forecasting. At present it is believed that some degree of success is being achieved with the numerical

method, particularly in the upper-air prognosis, but little success beyond 48 hours has been realized on the surface by any of the presently utilized techniques.

It is felt that the foundation of long range forecasting is the recognition of the global nature of weather patterns, and correspondingly, that weather conditions in a particular region may in some way be affected by far off events that are seemingly unrelated. Further, it is felt that by utilizing the weather typing technique on a hemispheric basis, perhaps in conjunction with an upper-air numerical method, a successful long range technique for surface forecasting can be developed. Therefore, it is along this avenue of reasoning that this paper is projected.

2. PROCEDURE

Weather typing involves the separation of weather situations into more or less distinct groups whose class characteristics are distinguished from those of other groups. Franke[1] defines weather typing in this manner:

> Some particular anomaly is noted repeatedly in a series of weather maps (e.g. The center of a high pressure cell occupying one predominant position), and from this other parameters are observed, statistically, that occur near and/or in conjunction with this anomaly. By continuous observations, beginning with the basic predominant feature and building around it, an ideal map is constructed which protrays the usual, or most representative picture of the weather in such a situation. Precipitation patterns, frontal locations, etc., may then be added to complete the map, giving as a final product a composite map showing all the salient features of a common weather situation, both temporal and spatial. In essence, the above can be stated in two words: Synoptic Climatology.

From the above definition it is evident that the procedure of developing weather types is a methodical process, both tedious and time-consuming.

The first step in typing weather on a hemispheric basis involves delineating the zones around the hemisphere. After studying previous work in weather typing [1, 2, 9] and taking into account the general circulation of the Northern Hemisphere, the boundaries of the zones were chosen as illustrated in Figure 1.

The limits of these zones are somewhat arbitrary since weather does not generate from invisible lines drawn on the surface of the earth. However, the western limit of Zone I

1. Personal conversation between the authors and Franke.

is in an area of frequent cyclogenesis off Japan; the western limit of Zone II is in the area of the Aleutian Low; the western limit of Zone III is in the area of the Icelandic Low; and the western limit of Zone IV is just to the east of the Ural Mountains. These limits also fit the water-land distribution around the hemisphere fairly well in that there are two predominantly continental zones and two predominantly maritime zones. A third consideration in choosing these boundaries is related to the work previously done in this field. Work done on a project for AROWA [4] was helpful in establishing the blocking types in Zones I and III. The considerable work done by Krick and Elliott [6, 8] on the North American Weather Types in Zone II made this perhaps the easiest zone to type. Hemispheric Types corresponding to Elliott's North American Types are listed in Appendix I. Elliott's Atlantic Types [5] and some idealized maps compiled by the British Weather Service in World War II [12] eased the typing task in Zone III.

After the hemispheric zones were set up and several years of Synoptic Weather Maps scanned, it was soon established that certain 500-mb patterns recurred again and again, and further, that each of these patterns had a unique surface sequence associated with it. This fact becomes especially important when it is realized that while the surface synoptic situation is continually changing during the life history of a particular type, the 500-mb picture is usually quasi-stationary. More specifically, the 500-mb flow is slow enough

in changing so as to allow the sequence to be followed on weather maps 24 hours apart, as were available in the Historical Series of Synoptic Weather Maps [10].

In the development of the original North American Weather Types by Krick and Elliott [11], an arbitrary six-day life cycle was assigned to each type and, due to lack of data, the upper-air flow was entirely disregarded. Both of these serious shortcomings are eliminated in the Hemispheric Types by use of the 500-mb data. Not only did the 500-mb data play a major role in the classification of the Hemispheric Types but it also delineated the life cycle of the individual type. As soon as a major change occured in the 500-mb flow pattern, the life cycle of the type was terminated and a new type was present.

The Hemispheric Types fall into three broad groups in each zone: Zonal flow types, ridge or meridional flow types, and blocking types. A general description of these groups follows in the next section.

Once the Hemispheric Types for each zone were delineated, a calendar was compiled. This calendar includes seven years of daily tabulations (September through April) and is attached as Appendix III.

3. GENERAL DESCRIPTION OF THE CLASSES OF FLOW

Zonal Flow Types

In zonal flow types there are no outstanding persistent upper-level crests and troughs such as appear in the meridional flow types, although small migratory ridges and troughs do appear. On occasion, such as in the Z-1 and Z-2 types of Zone II, a closed High appears at 500-mb above the polar cells (north of 55°) during the indicated portions of the life history of the type. Furthermore, the development of these Highs is a good indication that the type will either persist for 6 days or more or that there will be a transition to a closely related type. Differences between zonal flow types are measured primarily by the degree of northward shift of the zone of the westerlies aloft, and the corresponding shift in the mean storm tracks. The further south the storm track the more erratic the movement of the cyclonic centers. Accompanying this northward shift there appears at the surface weaker, smaller, and less stagnant high pressure areas in the polar regions composed of extremely cold air in the lower levels. [6,7]

In summary, the zonal type is that which exhibits weak amplitude of the 500-mb long-wave at about 45°N, but strong zonal flow (which may be displaced abnormally far south). The cyclone tracks are south of normal when accompanied by a southern displacement of the upper-level westerlies, and closed 500-mb Highs may occur north of 55°N.

In conjunction with the above, our classification system is developed in such a way as to take advantage of the northward shift of the westerlies aloft, and are numbered beginning with the type with the most southerly-displaced flow at 500-mb and increasing as the flow shifts to the north. i.e. The most meridional of the zonal types, the one where the Highs are the most intense, and in which, therefore, the belt of upper-level westerlies is in its southernmost position, is classified Z-1. The sequence of types corresponding to successively greater northward displacement of the 500-mb flow is as follows: Z-1, Z-2, Z-3, etc. (e.g. Figures 31,32,33.)

Ridge or Meridional Flow Types

Meridional flow types will normally exhibit an established long-wave ridge at 500-mb. This dominant feature will have considerable amplitude and is fairly stable insofar as the general circulation is concerned. There are favored zones for these ridges to appear and, once established, are quasistationary. These upper-level ridges normally overlie associated high pressure areas on the surface. Differences between meridional types are measured primarily by the zone dominated by the 500-mb crest. There is a normal tendency for ridges to generate in a particular area and then migrate to the eastward. The ridge line tilts northeast-southwest for those in the eastern portion, and northwest-southeast for those in the western part. Closed Highs are found sometimes in these ridges, but their centers are south of 50°N. If a block is established with a given type, then the same or

closely related type often follows. If no closed High is present in the ridge, then the type will be transitory and of short duration. The characteristics which make a type most distinct are best developed in the persistent cases. [6,7]

In summary, Meridional or Ridge types are characterized in the 500-mb flow by moderate to large amplitude of the long-wave at about 45°N. Closed Highs may be present in the ridges, but are south of 50°N. The storm tracks are normally meridional in nature, dipping far south in most cases, with recurvature to the north occuring in the vicinity of the upper-level trough to the east. Our classification system attempts to take into consideration the eastward propagation of the long-wave, and our types are numbered accordingly. i.e. The type with the 500-mb ridge in the most westerly position in the zone is classified R-1. The sequence of types corresponding to greater eastward displacement of the long-wave is as follows: R-1, R-2, R-3, etc.(e.g. Figures 6,7,8.)

Blocking Types

Elliott has defined a "block" as a closed High aloft poleward of 35°N. However, for the purposes of our classification system, and to simplify matters, we have arrived at less stringent requirements to determine whether or not a closed 500-mb High is "blocking". A good percentage of the time, especially in the summer when the belt of westerlies aloft is most northerly displaced, a closed 500-mb contour will exist north of 35°N, and yet this High will have virtu-

ally no effect on the track of the surface cyclones and the main flow to the north or south of this closed contour will be smoothly zonal. In such a case, to our way of thinking, the situation is definitely not "blocking". The ideal blocking situation includes a closed High at 500-mb, with a trapped or cut-off Low to the south at approximately the same longitude, the combination of which produces split flow in the belt of upper-level westerlies. [3] This condition is satisfied in some of our types. However, in other cases we considered that a blocking situation existed when the closed 500-mb High (within a good strong ridge) actually performed its function as a block, i.e. The paths of the major surface storms were diverted either extremely far south or north of their normal track, or around the associated high pressure area on the surface. (e.g. Zone II, Type B-1) This last situation is extremely meridional and is usually found in a well developed 500-mb ridge that includes a closed High, although not necessarily a trapped Low at lower latitudes. The development of these blocks is a good sign that the accompanying type will persist for several days, or that a closely related type will follow in short order. As the normal progression of these blocks is from west to east, we have utilized the same classification scheme as in our Ridge types. i.e. The type with the most westerly-displaced upper-level block or ridge in the zone is called B-1. The sequence of types corresponding to successively greater eastward displacement of the principal block (ridge) is as follows: B-1, B-2, B-3, etc.(e.g.Figures 13,14,15)

4. DESCRIPTION OF THE TYPES

In this section are presented the individual types that were developed. The types are arranged by zones and include a written resume to go along with each composite map.

Areas of persistent high pressure are delineated by solid black lines and solid arrows indicate trajectories of the centers. The mean storm tracks are shown as double dashed lines, with the successive daily positions of the centers of the Lows indicated by small circles. It must be emphasized that the indicated movements are only for the ideal situations and there will be some variation from case to case. Average typical intensities of the centers of action are noted on the diagrams as an aid to the reader in locating areas of deepening, etc., and further to aid the forecaster in the evaluation and typing of the current weather map. The mean 500-mb flow during the life history of the type is indicated in red.

The descriptive material and typical intensities pertain to the winter season only. However, as type characteristics vary only slightly from season to season, these differences are what normally may be expected from seasonal climatic variations. For ready reference to the reader, a pictorial legend is presented below:

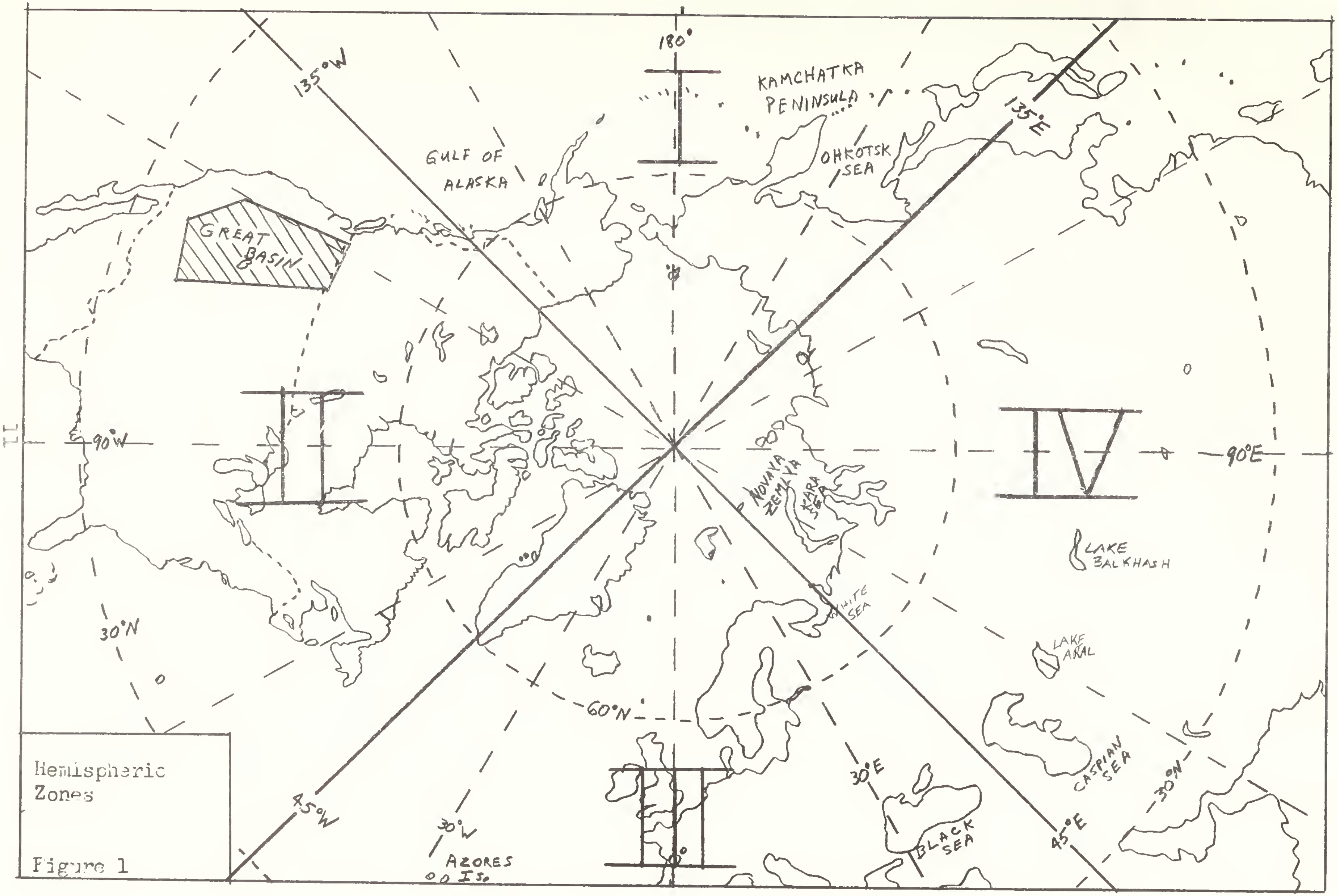
Area of persistent high pressure

Area of persistent low pressure

Trajectory of high pressure area

Track of Low centers with average 24 hour movement and typical intensity

Ridge



Hemispheric Zones

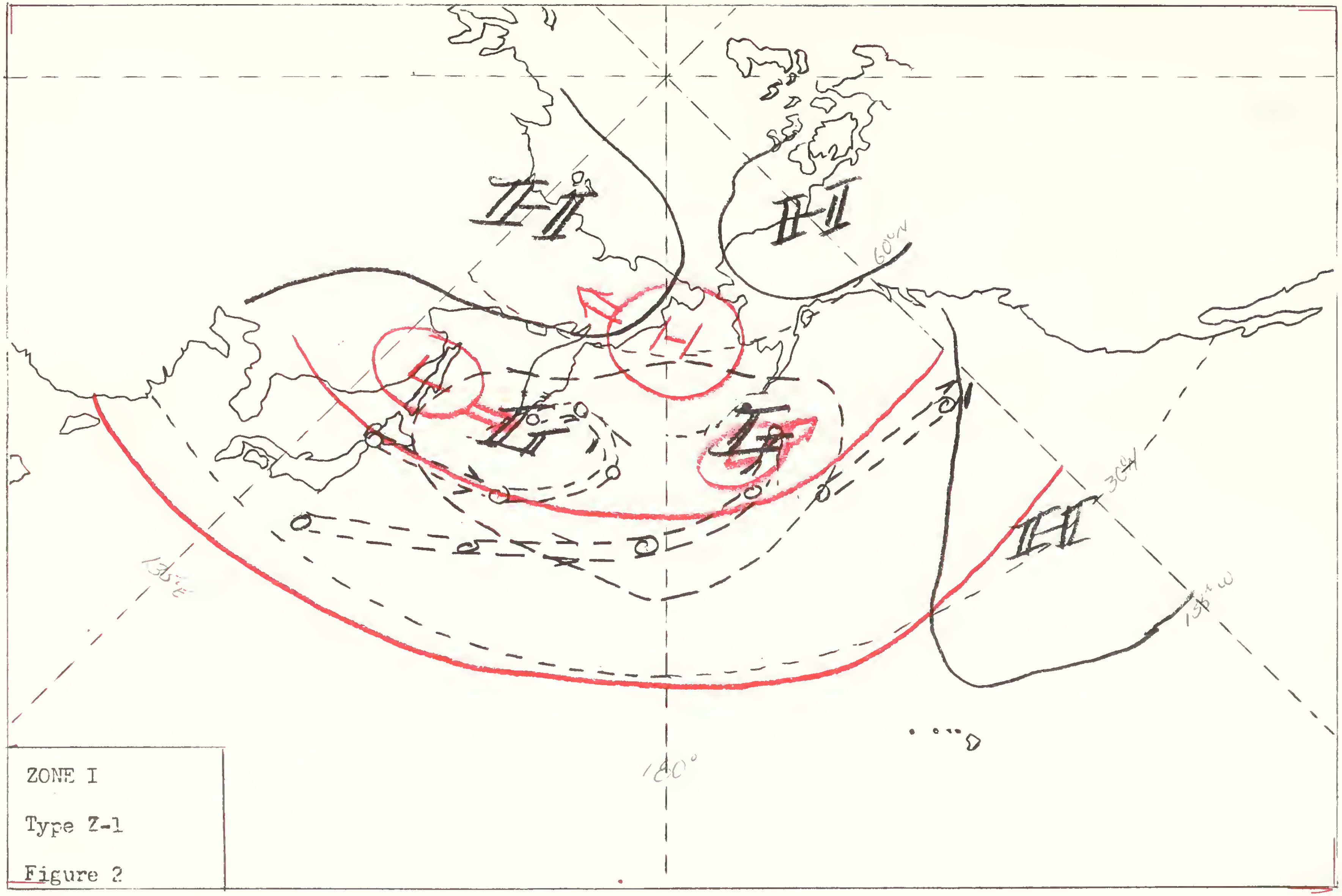
Figure 1

ZONE I Type Z-1

This is probably the most common type in the Pacific. At the 500-mb level the main current from the Asian Continent eastward is a narrow zonal stream. A dynamic high pressure cell migrates from either Alaska to Northeast Siberia or from the Aleutian area northward to the Arctic. This is particularly true when this type is unusually persistent (6 days or more).

On the surface an extensive area of high-pressure covers Alaska and Northeast Siberia. The Eastern Pacific High extends out almost to the Hawaiian Islands. Frontal systems moving off the coast of Asia swing northeastward and occlude southeast of the Kamchatka Peninsula. Low centers associated with these occluding frontal systems drift westward and fill. Waves forming south of Japan on the trailing edge of fronts move rapidly eastward and occlude near the Gulf of Alaska. Skagerraking frequently occurs in this area, the new low centers moving eastward toward the northwest coast of the United States. Because the pressure values of the low pressure centers varied considerably in each appearance of this type no typical values were assigned them in Figure 2.

In September and April the main upper-air current is usually about 10° of latitude north of that indicated in Figure 2. This type corresponds to Elliott's Pacific Region Type E.



ZONE I

Type Z-1

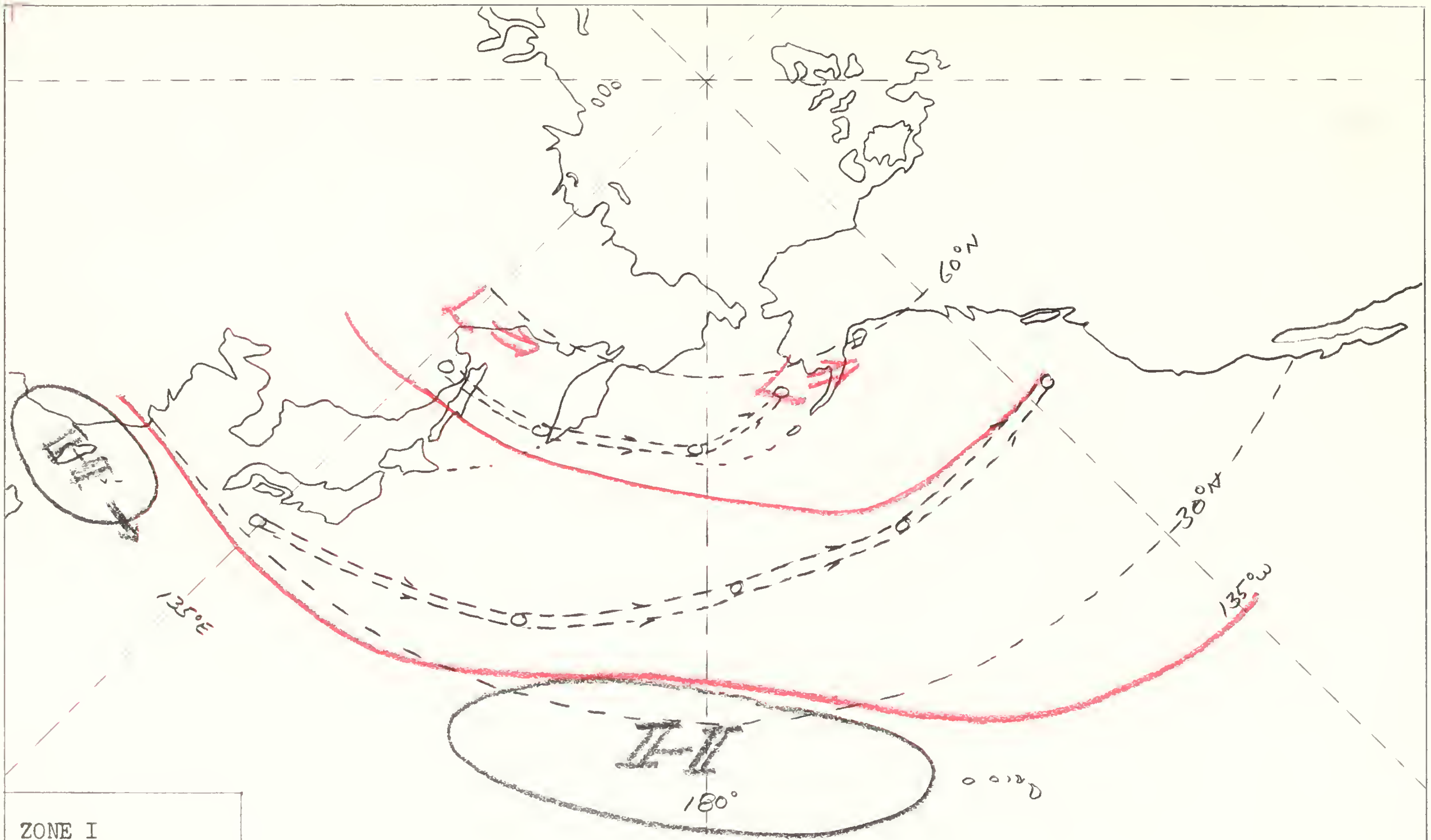
Figure 2

ZONE I Type Z-2

The 500-mb main current is a narrow stream that flows zonally from over Japan to the United States Coast. There is usually a relative tight contour gradient across this flow.

On the surface low-pressure centers move off the Asian Coast under the 500-mb main current and move very rapidly across the Pacific. These lows frequently cover 1200 miles in 24 hours. Because the pressure values of these low-pressure centers varied considerably in each appearance of the type no typical vales were assigned to them in Figure 3. Small sub-tropical high cells migrate across the Pacific south of 30°N latitude.

This type does not seem to be very persistent, seldom lasting more than four days. It is usually followed by a Type Z-1.



ZONE I

Type Z-2

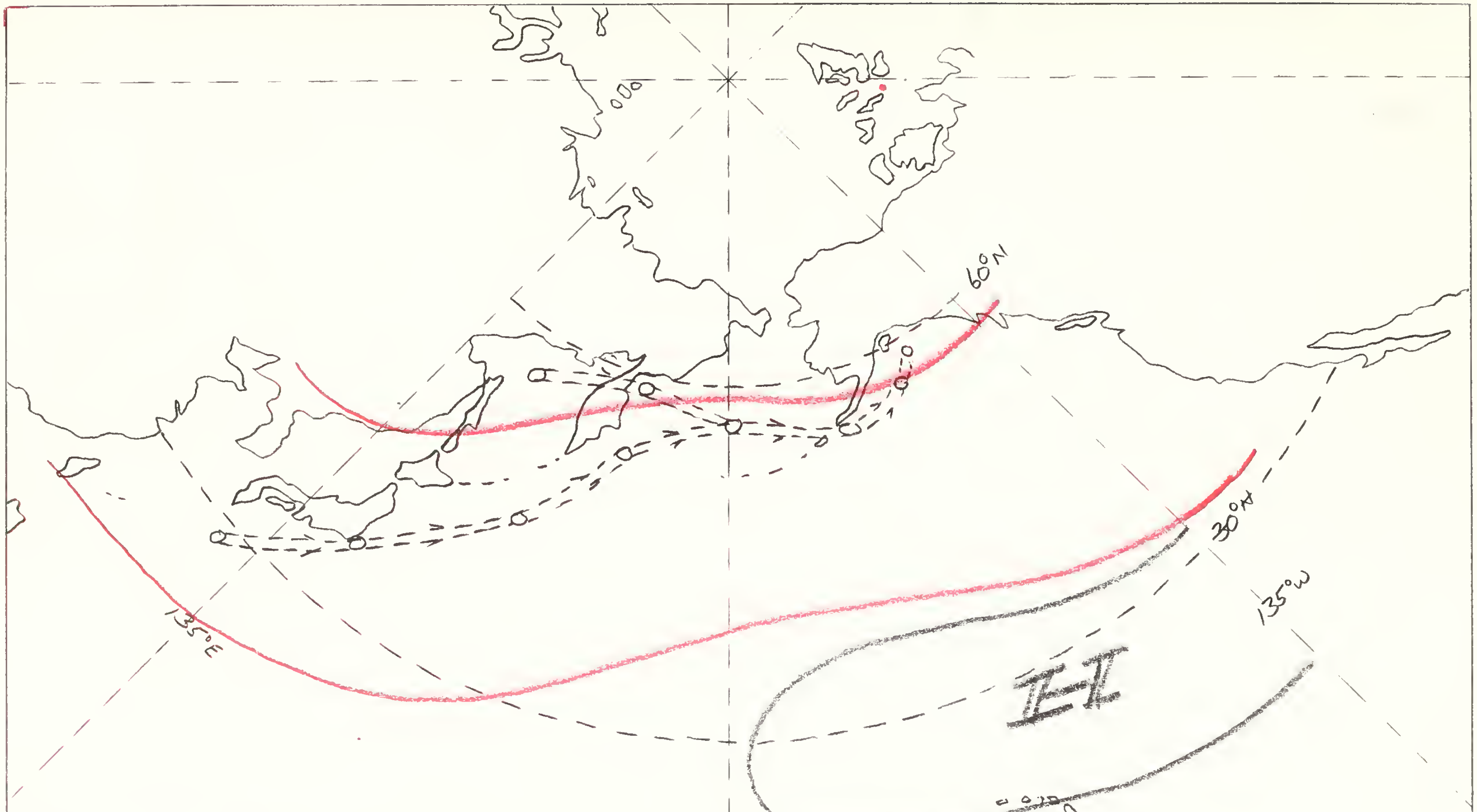
Figure 3

ZONE I Type Z-3

The main current at 500 mb is relatively broad, flowing slightly north of east across the Pacific Ocean.

On the surface there is usually a dynamic high-pressure cell that extends from the Eastern Pacific out to about the 180° Meridian and not too far north of 30°N latitude. Low-pressure centers move from the area south of Japan northeastward up the Japan and Kamachatka Peninsula Coasts into the Bering Sea and thence eastward into the Gulf of Alaska. Occasionally low centers move off the Asian Continent near 60°N latitude crossing north of the Kamchatka Peninsula on an eastward track to the Gulf of Alaska. The low centers usually stagnate and fill in the Gulf of Alaska. Because the pressure values of the low pressure centers varied considerably during each appearance of the type no typical values were assigned to them in Figure 4.

This type corresponds to Elliott's Pacific Region Type B.



ZONE I

Type Z-3

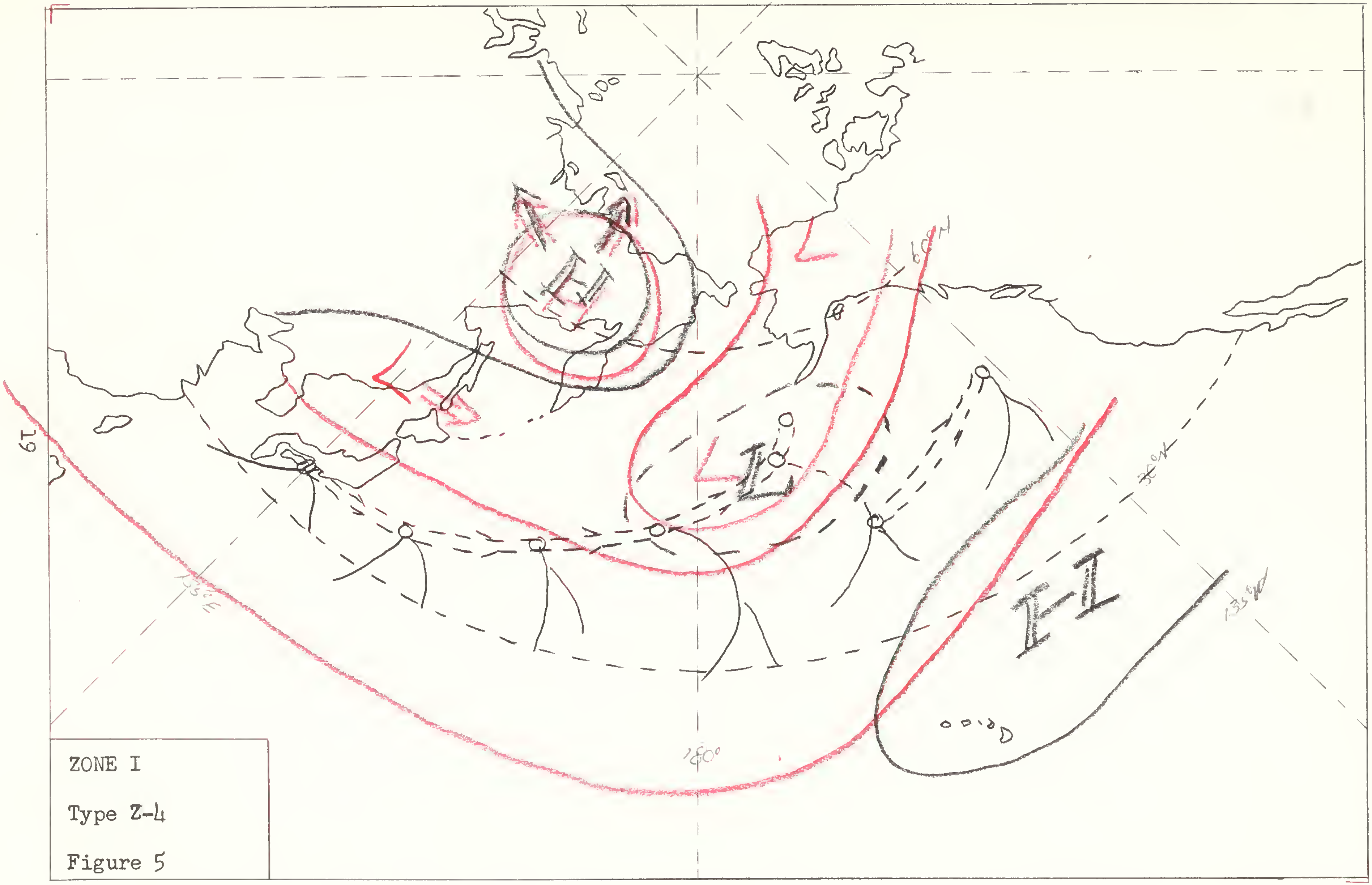
Figure 4

ZONE I Type Z-4

At 500 mb the main current flows off the Asian Continent over Japan eastward across the Pacific. Near mid-ocean the current swings slightly north. A dynamic high-pressure cell is present over Northeast Siberia in the initial days of this type. A type change can be expected shortly after the high cell moves north, east, or starts to weaken in the geographic position indicated in Figure 5. Low-pressure centers move eastward at about 15° of longitude per day and deepen rapidly. With weather maps spaced 24 hours apart, this gives the appearance of a low center over Alaska pushing down toward mid-Pacific.

On the surface frontal systems move from the area south of Japan rapidly eastward occluding in the Central Pacific. Skagerraking frequently occurs and the new low centers move eastward under the upper-air flow. The succession of low-pressure centers moving into the Aleutian area keeps the Central Pacific under the influence of cyclonic circulation. Because the pressure values of the low centers varied considerably during each appearance of this type, no mean values were assigned to them in Figure 5.

This type generally follows a Type Z-1 or a blocking type in which the high cell moves toward Northeast Siberia. Type Z-4 corresponds to Elliott's Pacific Region Type E.



ZONE I

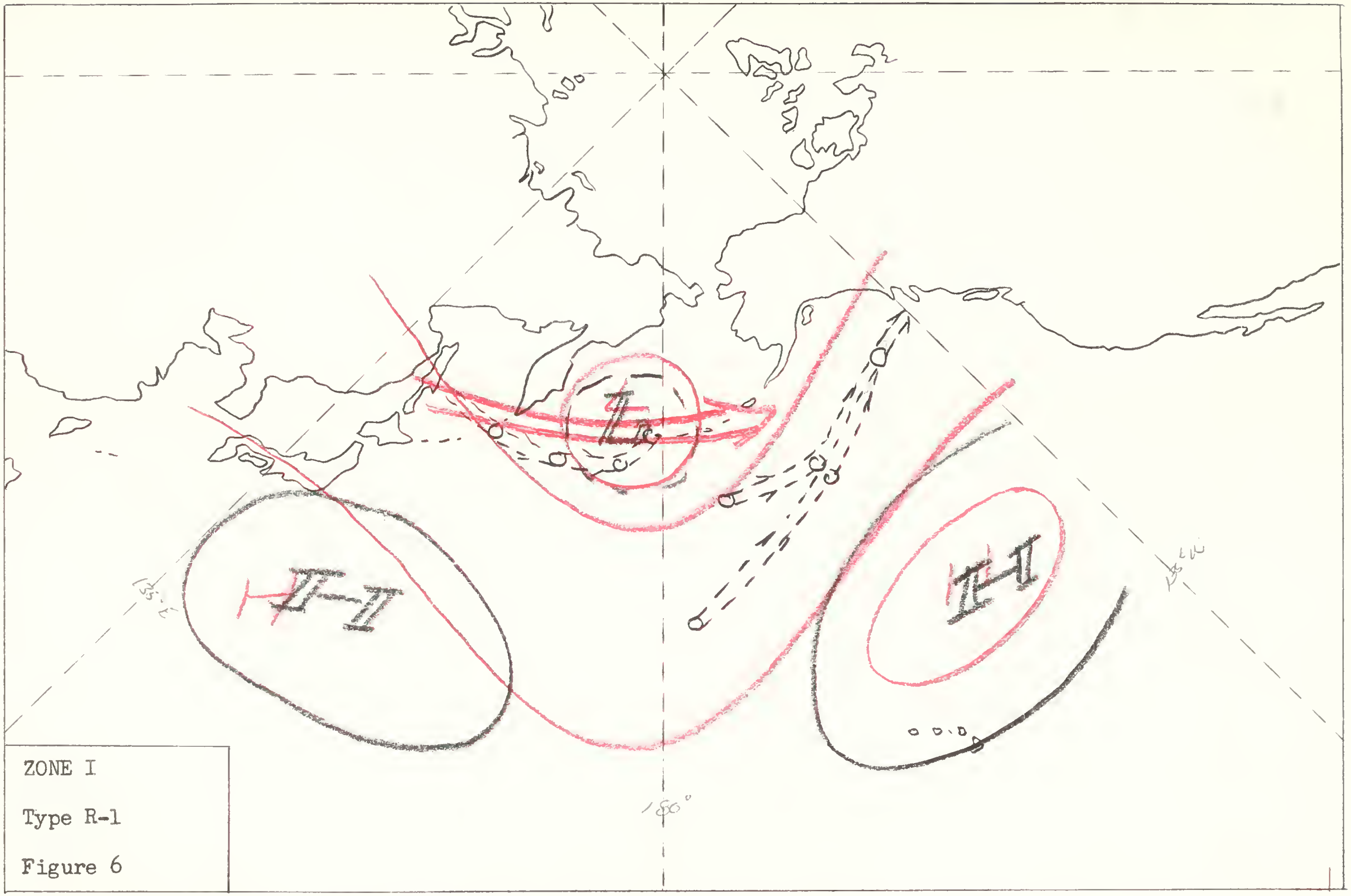
Type Z-4

Figure 5

ZONE I   Type R-1

This type is probably the least stationary of all 500-mb flow patterns in Zone I. A closed low-pressure center at 500 mb moves over the Asian Coast in the Okhotsk Sea region. The main current is south of this low-pressure cell so that the 500-mb flow pattern looks much like a "V" moving across the Pacific. This trough usually reaches mid-Pacific in three days. Dynamic high-pressure cells are oriented on either side of this trough near 30°N latitude.

On the surface low-pressure centers move off the Asian Coast north of Japan and swing up into the Bering Sea where they stagnate and fill. New low-pressure centers frequently form ahead of the upper-air trough in mid-Pacific and move rapidly up into the Gulf of Alaska. Because the pressure values of the low centers varied considerably during each appearance of this type, no typical values were assigned to them in Figure 6.



ZONE I

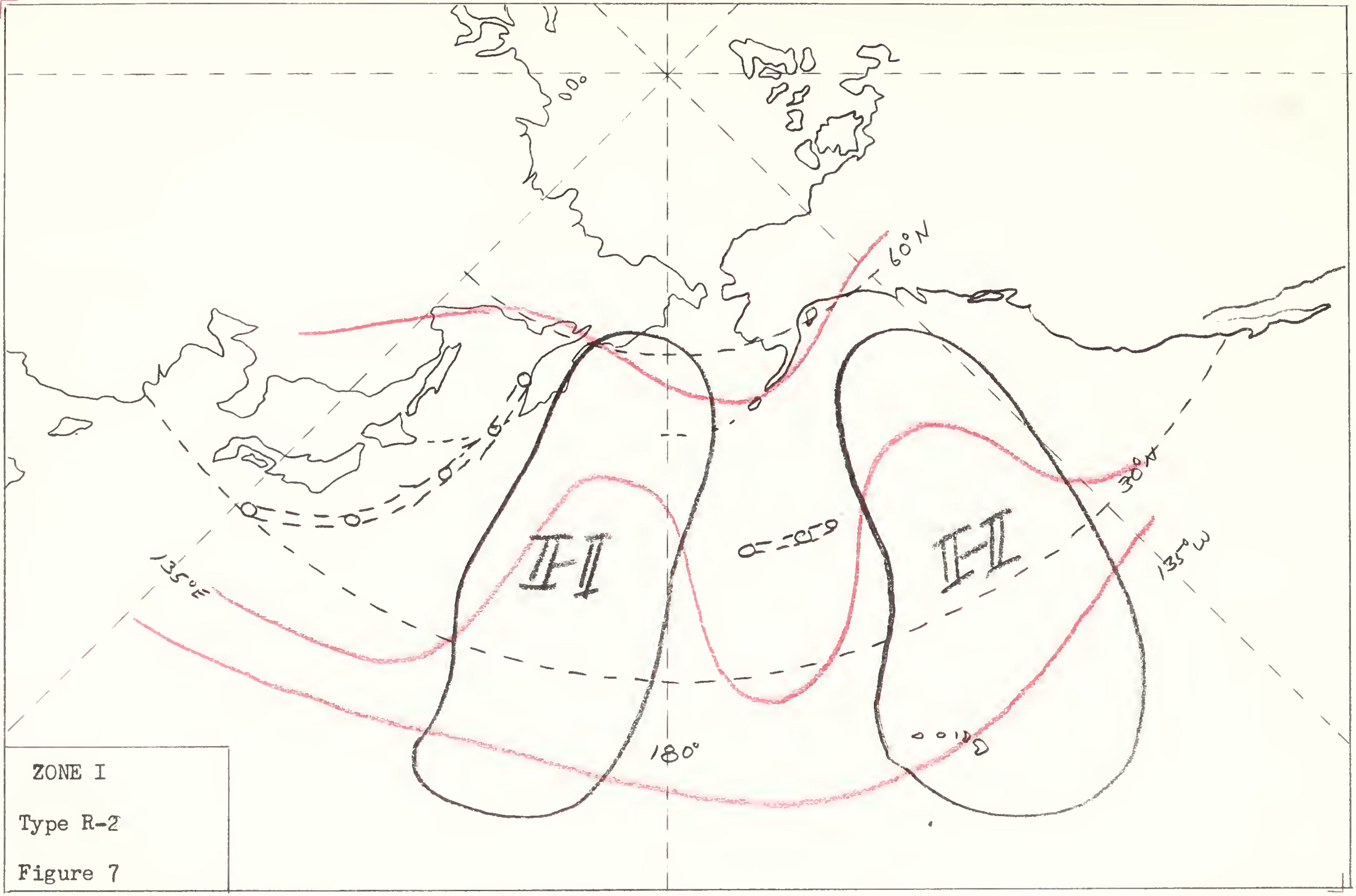
Type R-1

Figure 6

ZONE I   Type R-2

This type is easily recognized by its unique 500-mb flow pattern. There are two very prominent ridges with a deep trough between them over the Central Pacific.

On the surface dynamic high-pressure cells associated with the 500-mb ridges extend northward to almost 60°N latitude. Low pressure centers south of Japan move rapidly up the Japanese Coast toward the Kamchatka Peninsula, otherwise the surface picture is almost stationary. Systems in the Central Pacific tend to weaken rapidly during the course of this type. Because the pressure values of the low centers varied considerably during each appearance of this type no typical values were assigned to them in Figure 7.



ZONE I

Type R-2

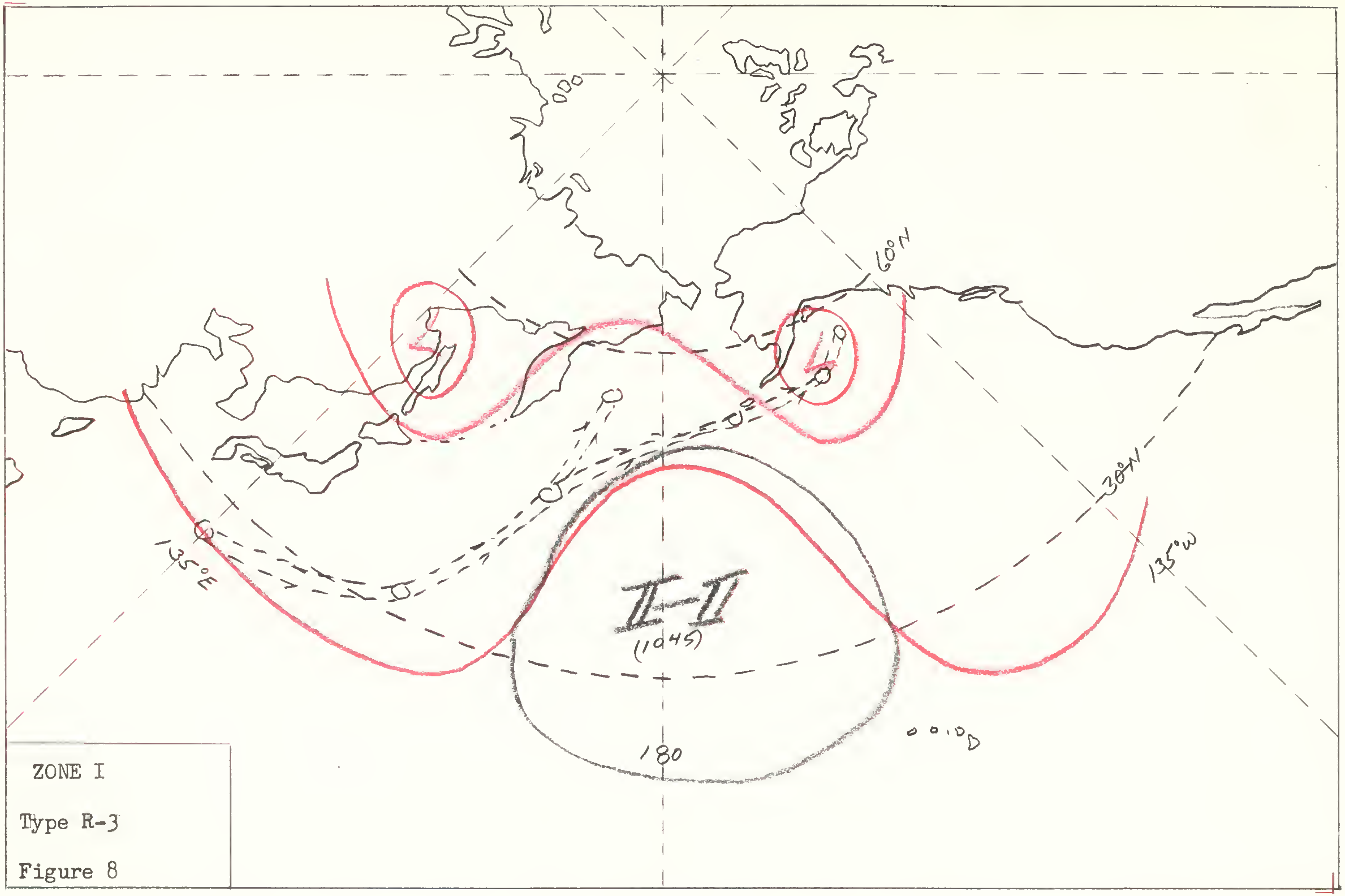
Figure 7

ZONE I Type R-3

This type is identified by a ridge at 500 mb that builds north near the 180° Meridian. This ridge frequently extends north to 50°N latitude and hence the flow is quite meridional. Cold low centers of a quasistartionary nature are located over the Gulf of Alaska and north of Japan.

On the surface a strong dynamic high cell (frequently 1045-mb) is present under the upper-air ridge. Low-pressure centers move from south of Japan rapidly northward under the upper-air current around the high cell and into the Gulf of Alaska where they stagnate and fill. As the upper-air ridge builds north, low-pressure centers tend to be steered into the Bering Sea where they stagnate and fill. Because the pressure values of the low centers varied considerably during each appearance of this type no typical values were assigned to them in Figure 8.

This type usually lasts three to four days and is frequently followed by a Type B-5 or a Type R-4, B-5 sequence. Type R-3 corresponds to Elliott's Pacific Region Type Bs



ZONE I

Type R-3

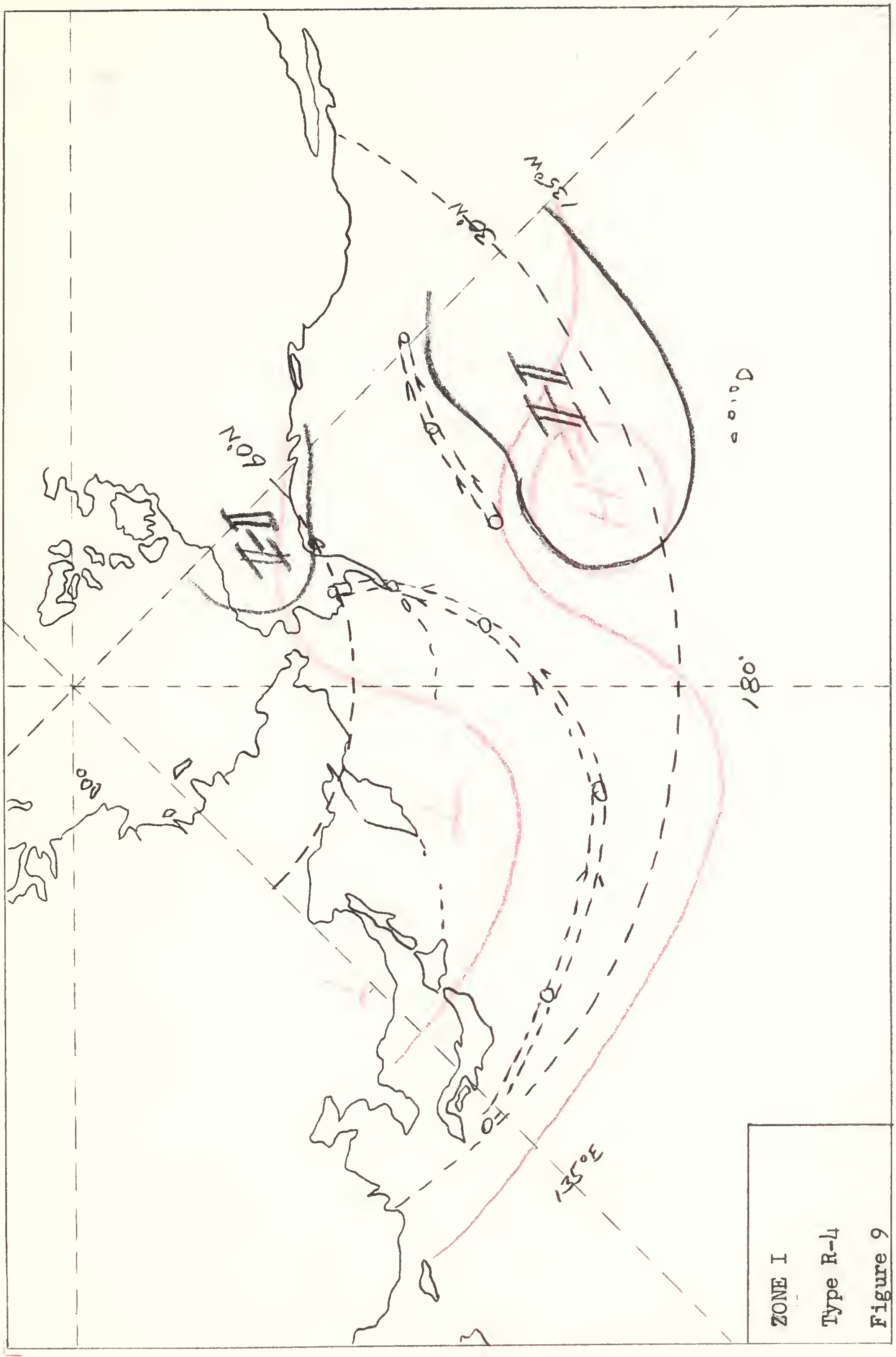
Figure 8

ZONE I   Type R-4

The identifying feature of this type is a ridge north of the Hawaiian Islands at 500 mb. Frequently there is a closed dynamic high present in the ridge. The ridge does not seem to build very far north but moves slowly to the eastward.

On the surface the Eastern Pacific High extends out to about 165°W longitude. An area of high-pressure usually covers Alaska also. Low-pressure centers move rapidly from the area south of Japan under the upper-air flow into Alaska. Low-pressure centers forming ahead of the upper-air trough occasionally move eastward toward the Unites States Coast. Because the pressure values of the low-pressure centers varied considerably during each appearance of this type no typical values were assigned to them in Figure 9.

This type usually lasts only four days and occurs generally in the Spring and Fall months.



ZONE I

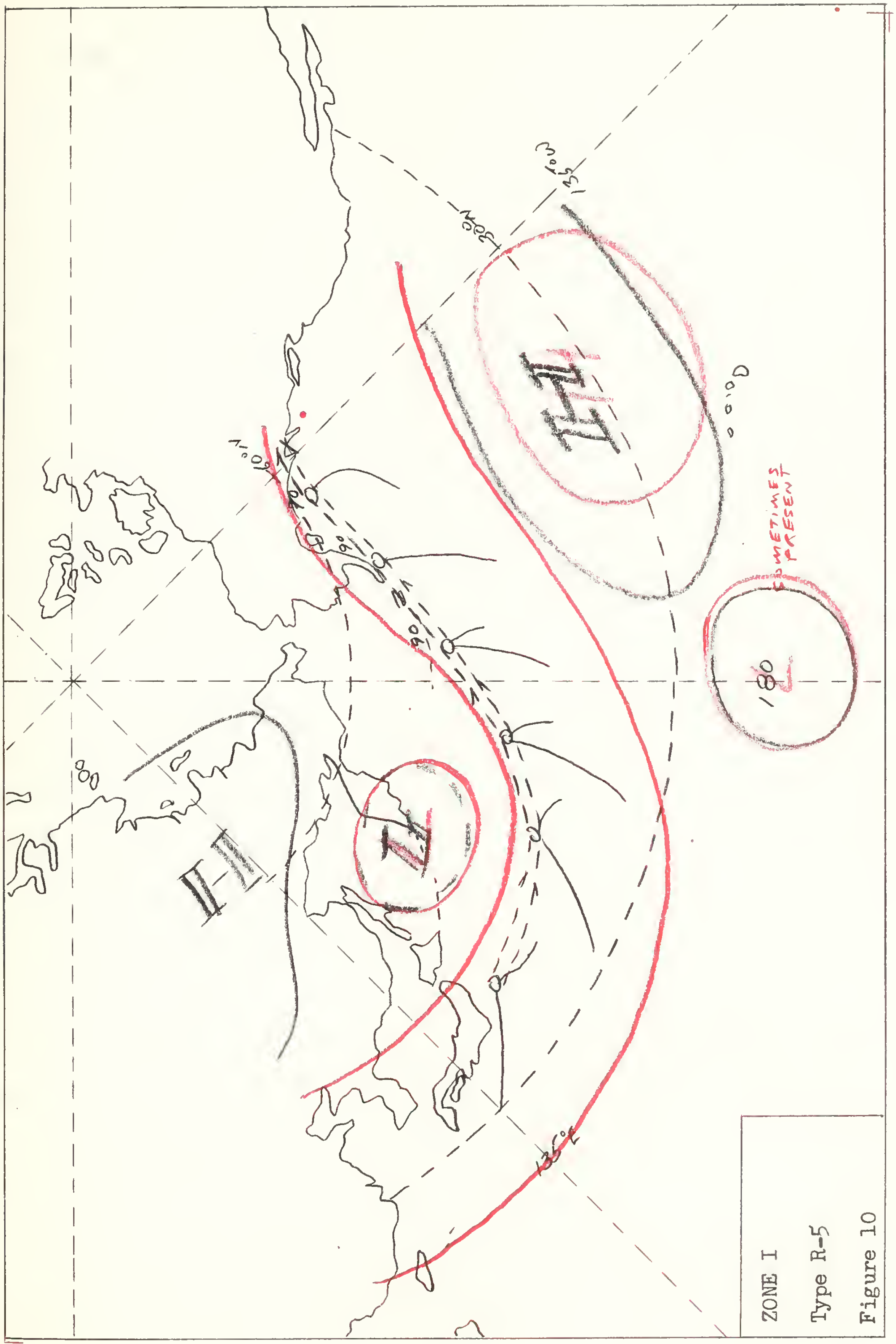
Type R-4

Figure 9

ZONE I   Type R-5

The ridge that identifies this type at 500 mb is located near 150°W longitude. A closed dynamic high cell is centered near 150°W longitude and 30°N latitude. At times there is a cold low cell to the southwest of this high. The ridge does not build very far north; hence the main flow is not too meridional. A cold low center moves slowly eastward over Northern Japan.

On the surface the Eastern Pacific High extends out to near 170°W longitude. Low-pressure centers move from the Japanese area northeastward under the upper-air flow into the Gulf of Alaska.



ZONE I

Type R-5

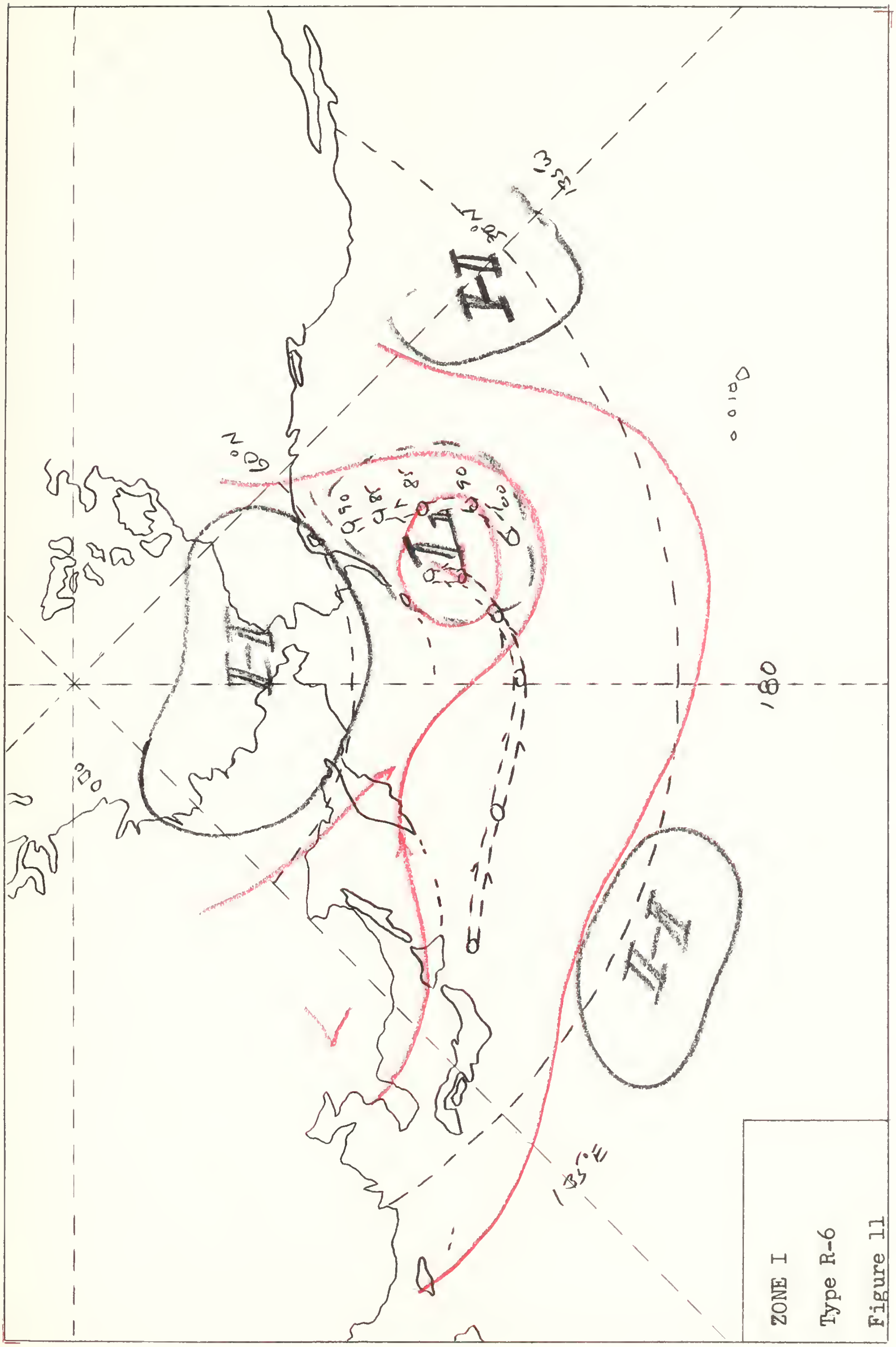
Figure 10

ZONE I Type R-6

The identifying feature of this type is the deep trough and associated high latitude blocking system which exists near 165°W longitude. If a broad zonal current exists moving off the Asian Coast (indicated by the northern and southern stream-lines in Figure 11) it is soon funneled into a narrow stream south of the cold low center. More frequently the main current flows off the Asian Continent in a narrow stream (indicated by the southern and the streamline over Korea in Figure 11), then flows over a slight ridge at 160°E longitude and under the cold low center. In both of the above cases the main current then goes northeastward over a ridge located between 135°W longitude and the United States Coast.

On the surface Alaska and Northeast Siberia are usually covered by an area of high pressure. The Eastern Pacific High extends out to about 135°W longitude. With broad zonal flow over the Asian Coast low-pressure centers move north of the Kamchatka Peninsula into the Bering Sea and fill. More common, associated with strong winds over Japan, is the formation of low pressure centers in the Yellow Sea region. These lows move under the upper-air flow into the area south of the Aleutians where they stagnate. Wave Cyclones form ahead of the upper-air trough in this region and move northward into Alaska where they soon lose their identity.

This type is associated with a zonal type or western block-ing type in Zone IV and Types Z-3, R-5, or B-1 in Zone II.



ZONE I
Type R-6
Figure 11

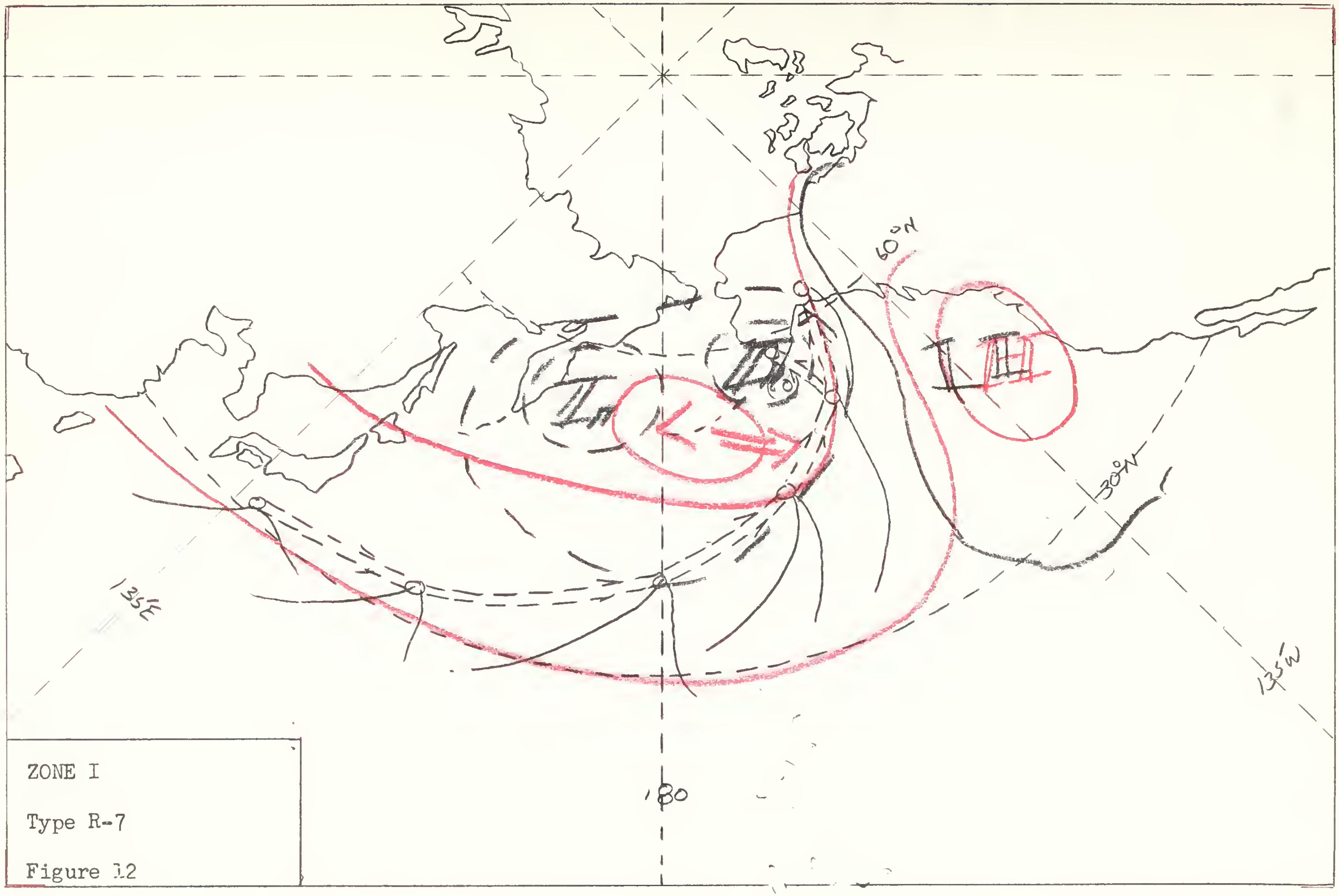
ZONE I Type R-7

This type is identified at 500 mb by a ridge that builds rapidly northward at about 135°W longitude. The main 500-mb current is concentrated in a relatively narrow stream that crosses Japan and flows eastward in a zonal manner until it turns sharply northward to flow over the ridge. There is a dynamic low center in the Central North Pacific area which pushes slowly eastward.

On the surface the Eastern Pacific High builds northward under the upper-air ridge. This high frequently reaches as far north as Point Barrow, Alaska. Cyclonic circulation dominates the Central North Pacific as successive low pressure centers move into the Gulf of Alaska area. These centers usually drift slowly westward from the Gulf of Alaska and fill. Frontal systems associated with the low-pressure centers occlude and undergo frontolysis on the western side of the high.

The central pressure of the surface low in the Aleutian area is usually near 966 mb. Because the pressure values of the low-pressure centers feeding into this area varied considerably during each appearance of this type, no typical values were assigned to them in Figure 12.

Type R-7 corresponds to Elliott's Pacific Region Type Bn.



ZONE I

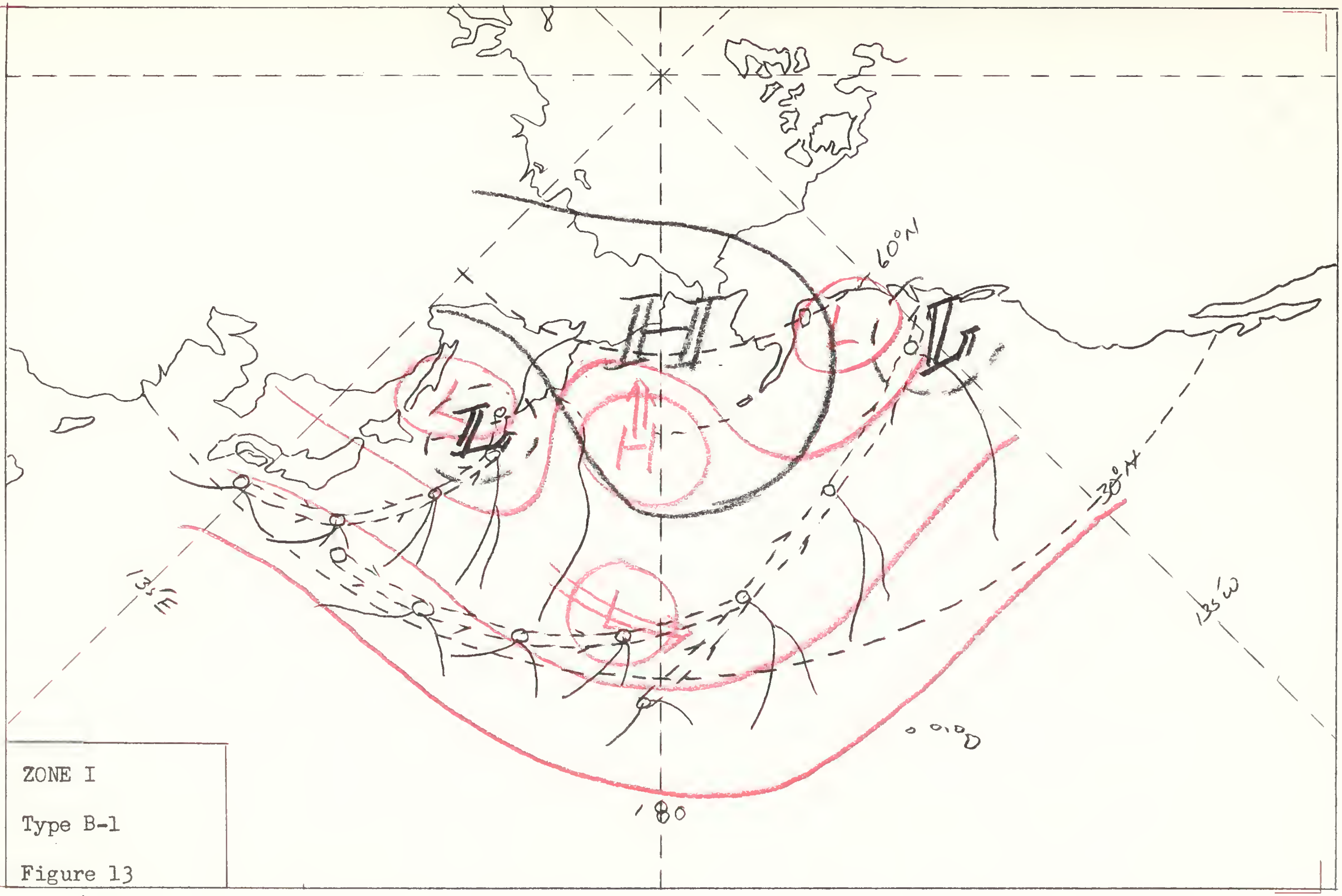
Type R-7

Figure 12

ZONE I Type B-1

This type is identified by a blocking system located between 165°W longitude and the 180° Meridian at 500 mb. The high cell tends to work its way slowly northward during the life of the type. The main current at 500 mb is split with the major part of the flow going south of the blocking system.

On the surface a high-pressure area usually covers Northeastern Siberia and the Bering Sea region. There is also a persistent cold low pressure center in the Okhotsk Sea region. Wave cyclones forming off Japan move northward into this area of low-pressure. The other major track of low pressure centers is south of the 500-mb blocking system and then up into the Gulf of Alaska. Waves sometimes form on the trailing edge of the Polar Front ahead of an upper-air trough that usually exists just east of the blocking system. These waves move northward into the Gulf of Alaska.



ZONE I

Type B-1

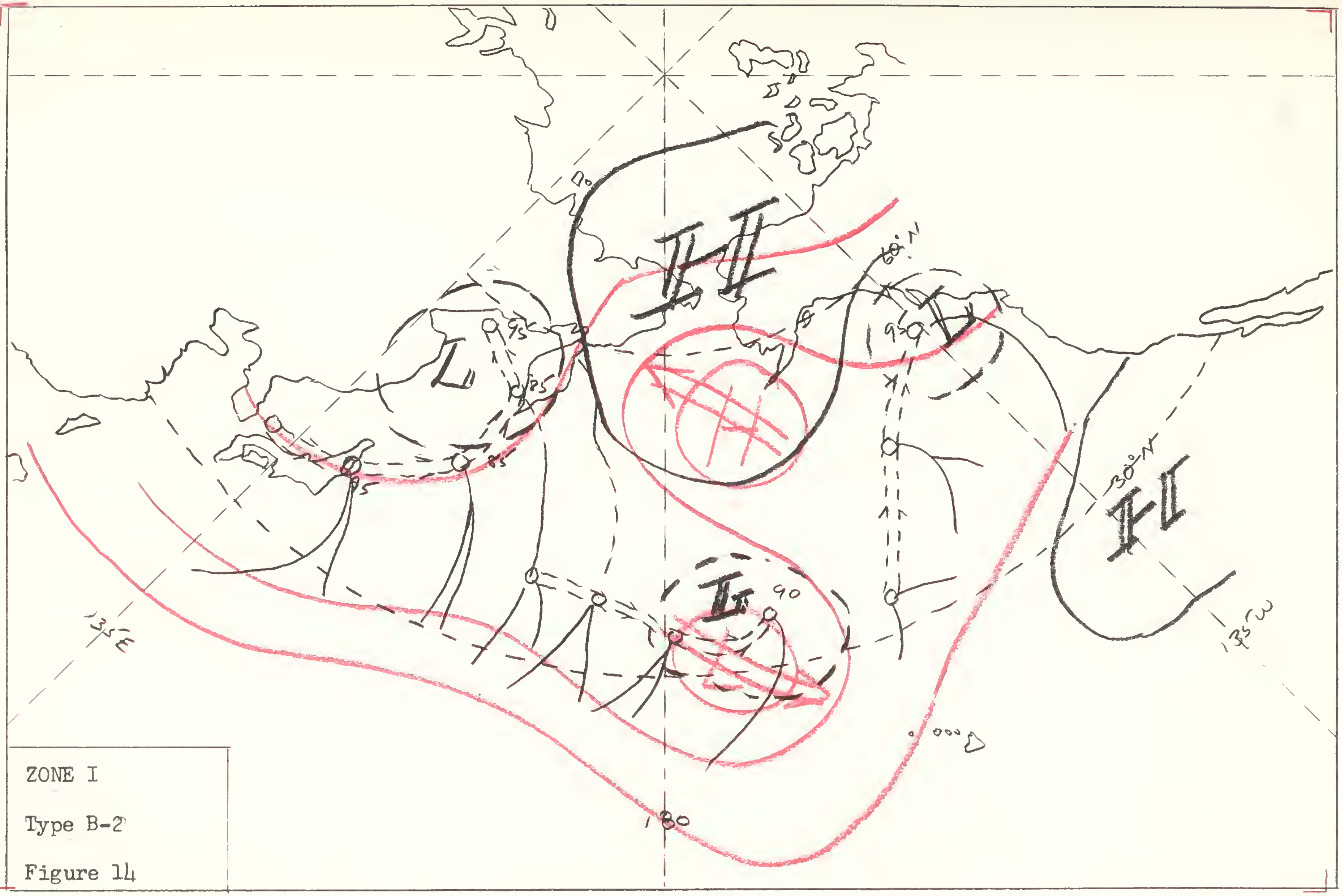
Figure 13

ZONE I Type B-2

The main current at 500 mb is split by an extensive blocking system located between 160°W longitude and the 180° Meridian. The high cell in this blocking system works slowly northwestward and the low moves to the southeastward at an equally slow rate.

On the surface an area of high pressure usually covers Alaska, the Bering Sea, and the western end of Siberia. Low pressure centers which move off the Asian Continent near the Sea of Japan and wave cyclones which form on trailing fronts south of Japan swing northward into the Okhotsk Sea. Low centers infrequently move northward of 60°N latitude without recurving to the west. Skagerraking frequently occurs as frontal systems associated with these low centers occlude. The new centers move southeastward in an erratic manner. Cyclogenesis frequently occurs north of the Hawaiian Islands. These low centers move rapidly northward into the eastern part of the Gulf of Alaska.

This is usually a very persistent type and is frequently followed by a Type B-4.



ZONE I

Type B-2

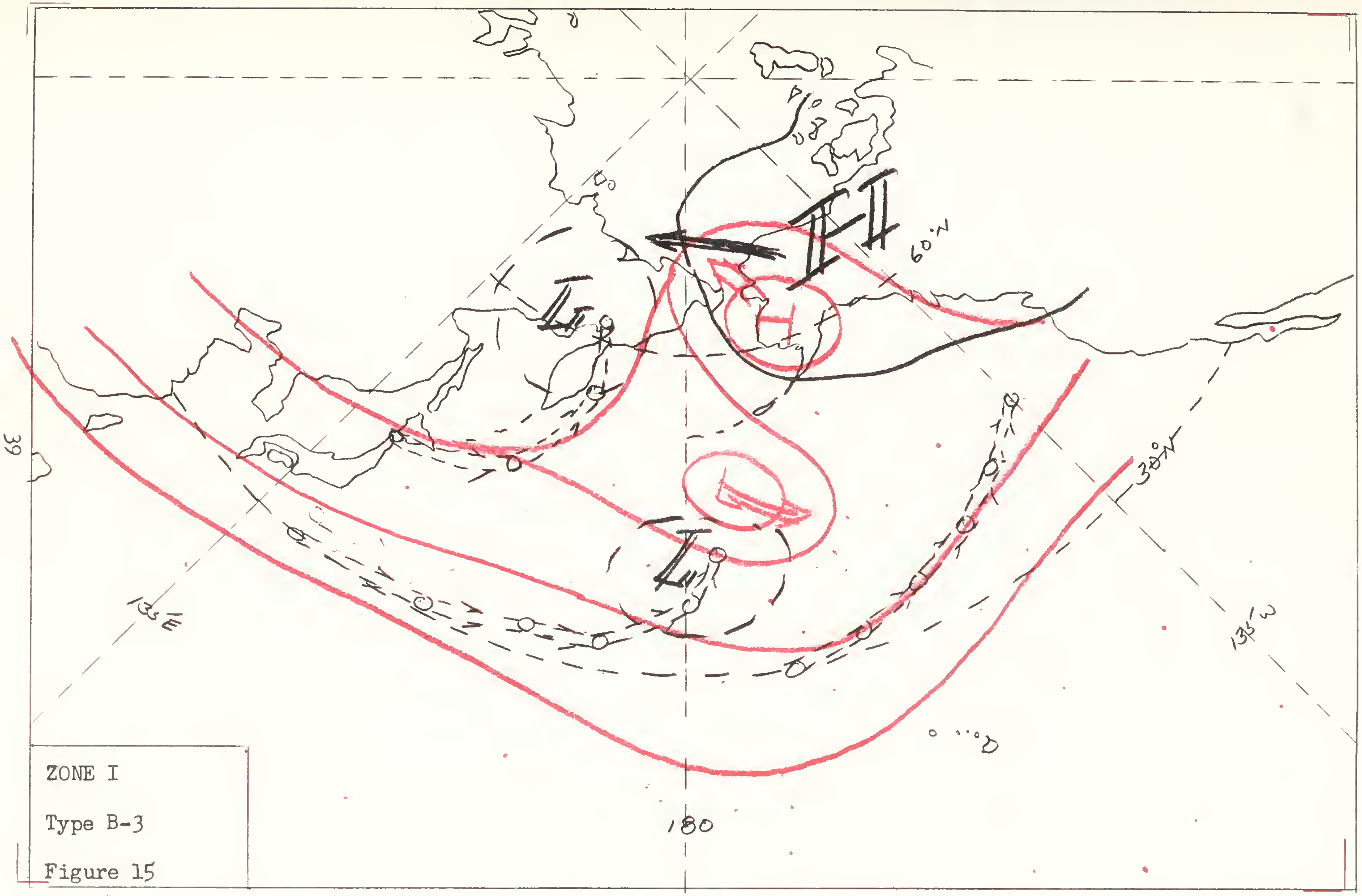
Figure 14

ZONE I Type B-3

This type is identified at 500 mb by a closed dynamic high located between 160°W longitude and the 180° Meridian at about 60°N latitude. This high moves in a north to northwest direction at a slow rate during the life of the type A cold low works southeastward from the Aleutian area. Most of the 500-mb main current flows south of this blocking system.

On the surface cold fronts moving off the Asian Continent develop wave cyclones which usually swing up east of the Kuril Islands and the Kamchatka Peninsula into Northeast Siberia. Low-pressure centers forming south of Japan move eastward feeding into the area of the cold low in mid-Pacific. Skagerraking frequently occurs in mid-Pacific. The new low-pressure systems move eastward in a slow and erratic manner.

This type normally lasts for five to six days.



ZONE I

Type B-3

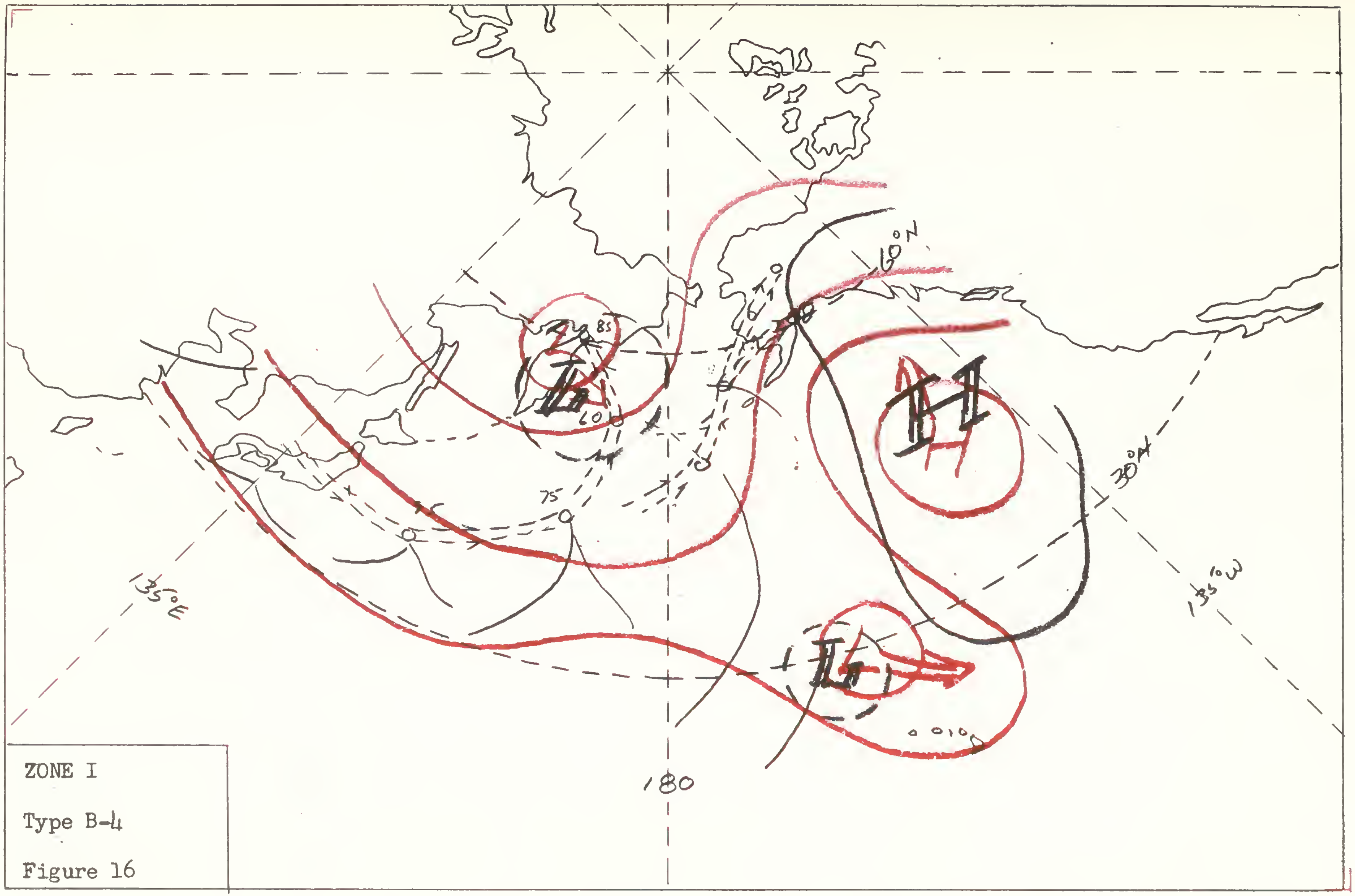
Figure 15

ZONE I Type B-4

During the life of this type a closed dynamic high center is located between 145°W and 160°W longitude. A cold low works slowly south of the high over the Hawaiian Islands area. There is generally a deep trough off the Asian Coast at 500-mb and a cold low over the Kamchatka Peninsula. Very little of the main 500-mb current flows south of the blocking system until the latter stages of the type.

On the surface a strong Eastern Pacific High cell covers the eastern part of the zone. Wave cyclones formed off the coast of Asia swing northward toward the Bering Sea, deepening and intensifying rapidly as they move. However, once they start to recurve west of the Kamchatka Peninsula they fill rapidly. Skagerraking occurs in mid-Pacific frequently. The new low-pressure centers are steered north under the upper-air flow into Alaska. In the initial stages of this type the low centers occasionally move through the Gulf of Alaska and continue eastward but normally they move into Alaska and quickly lose their identity. Waves also form on the trailing edge of fronts in the Hawaiian Islands area but their movement is erratic and they seldom last long.

This type usually lasts seven days and is followed by another blocking type. Type Z-4 or R-5 may be present for a few days subsequent to the next blocking type occasionally. Type B-4 corresponds to Elliott's Pacific Region Type A.



ZONE I

Type B-4

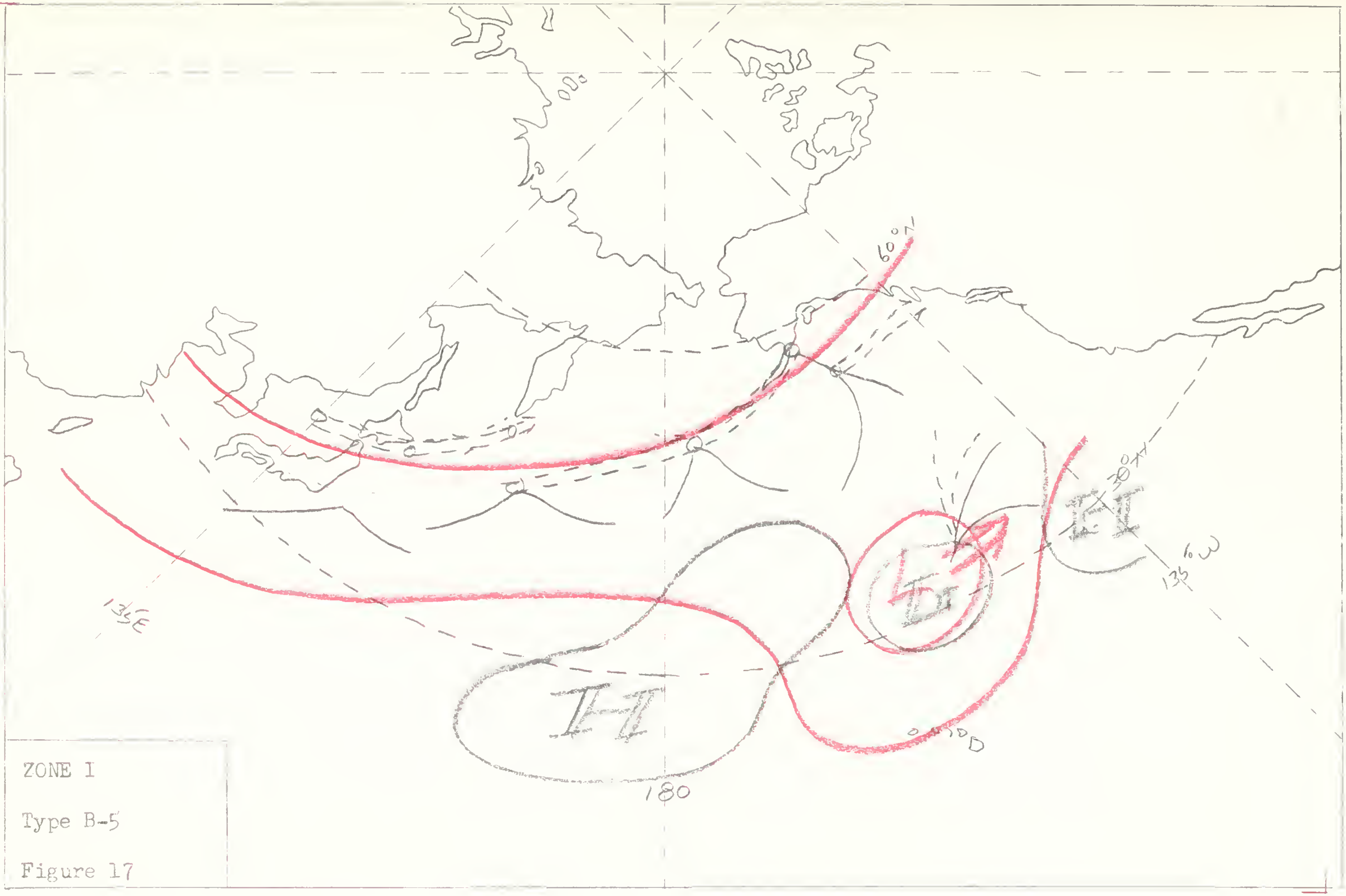
Figure 16

ZONE I Type B-5

The distinguishing feature of this type is the cold low center at 500 mb located northeast of the Hawaiian Islands. This Low moves toward the United States Coast and weakens to a trough usually. Sometimes this movement is rapid (three days) while at other times the low can be quite stationary for several days in the area between 150°W and 130°W longitude. The 500-mb main current is generally a narrow stream that flows zonally from south of Japan to the Canadian Coast with the exception of the branch that flows cyclonically around the cold low center.

On the surface there is a weak low center associated with the cold low aloft. Weak frontal systems are associated with this Low. Their movement is erratic and they seldom penetrate the United States Coast. Low-pressure centers move out of the Yellow Sea area and swing northeast, paralleling the Kuril Island chain. These usually recurve over the Continent and weaken rapidly. The other path of low-pressure centers runs from south of Japan up the Aleutian Chain into the Gulf of Alaska. As frontal systems occlude in this area Skagerraking frequently occurs and the new centers move eastward entering the North American Coast between 50°N and 60°N latitude. Because the pressure values of the low-pressure centers varied considerably in each appearance of this type no typical values were assigned to them in Figure 17.

This type is usually followed by a ridge type, particularly R-3.



ZONE I

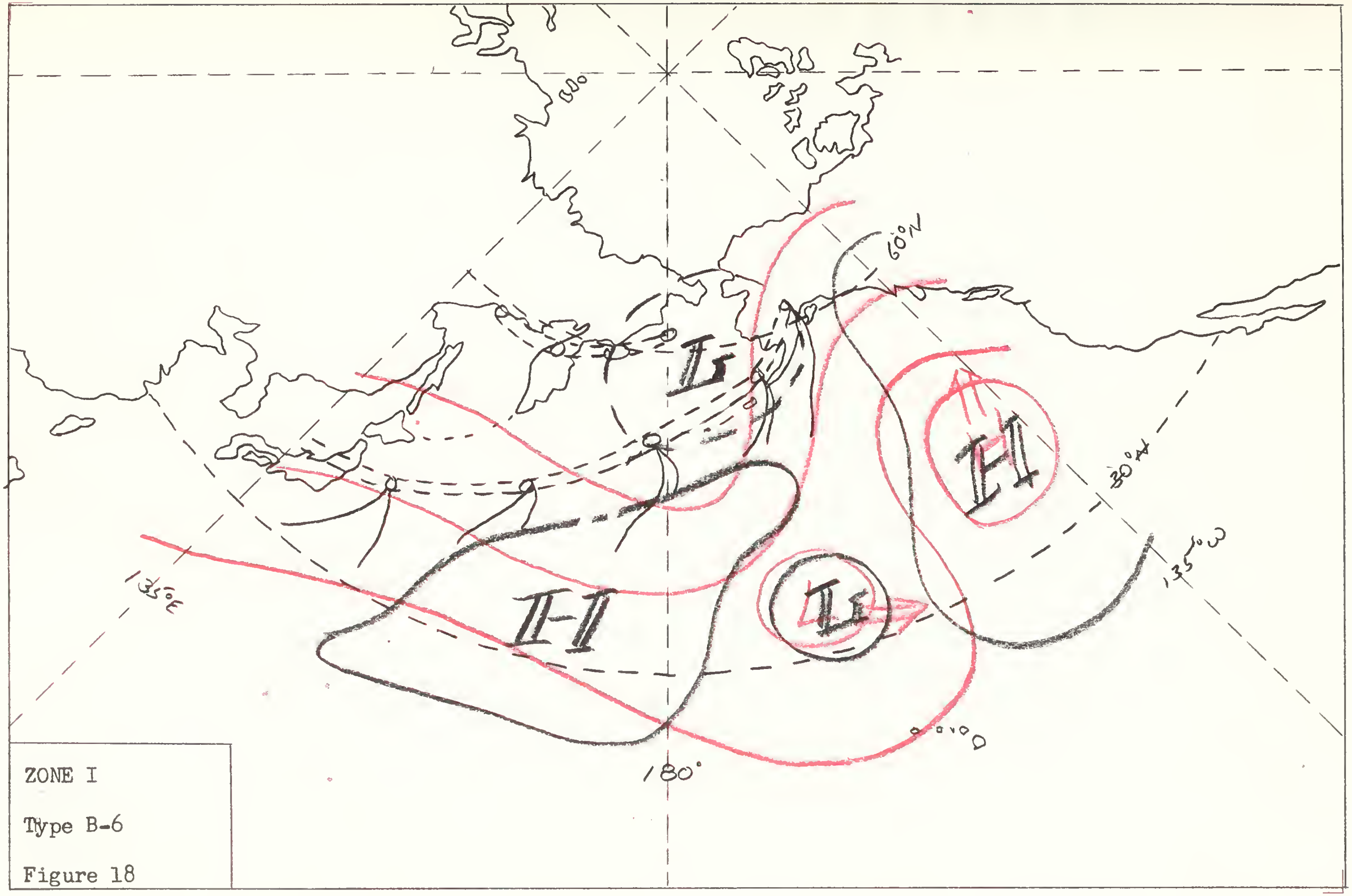
Type B-5

Figure 17

ZONE I   Type B-6

This type can be recognized at 500 mb by a closed dynamic High that develops between 130°W and 150°W then moves slowly in a northnortheasterly direction. A relatively stationary cold low is located north of the Hawaiian Islands. Very little of the 500-mb main current flows south of this blocking system until the latter stages of the type.

On the surface of the Eastern Pacific High cell covers most of the eastern part of the zone. Low-pressure centers moving off the Asian Continent north of Japan swing eastward across the Kamchatka Peninsula into the Bering Sea where they stagnate and fill. Wave cyclones forming southeast of Japan move northeast and deepen until they move into western Alaska. Once the low center moves into Alaska it rapidly weakens and loses its identity. During the life of this type the Bering Sea region is usually under the influence of a relatively deep cyclonic circulation. Because the pressure values of the low-pressure centers varied considerably in each appearance of the type no typical values were assigned to them in Figure 18.



ZONE I

Type B-6

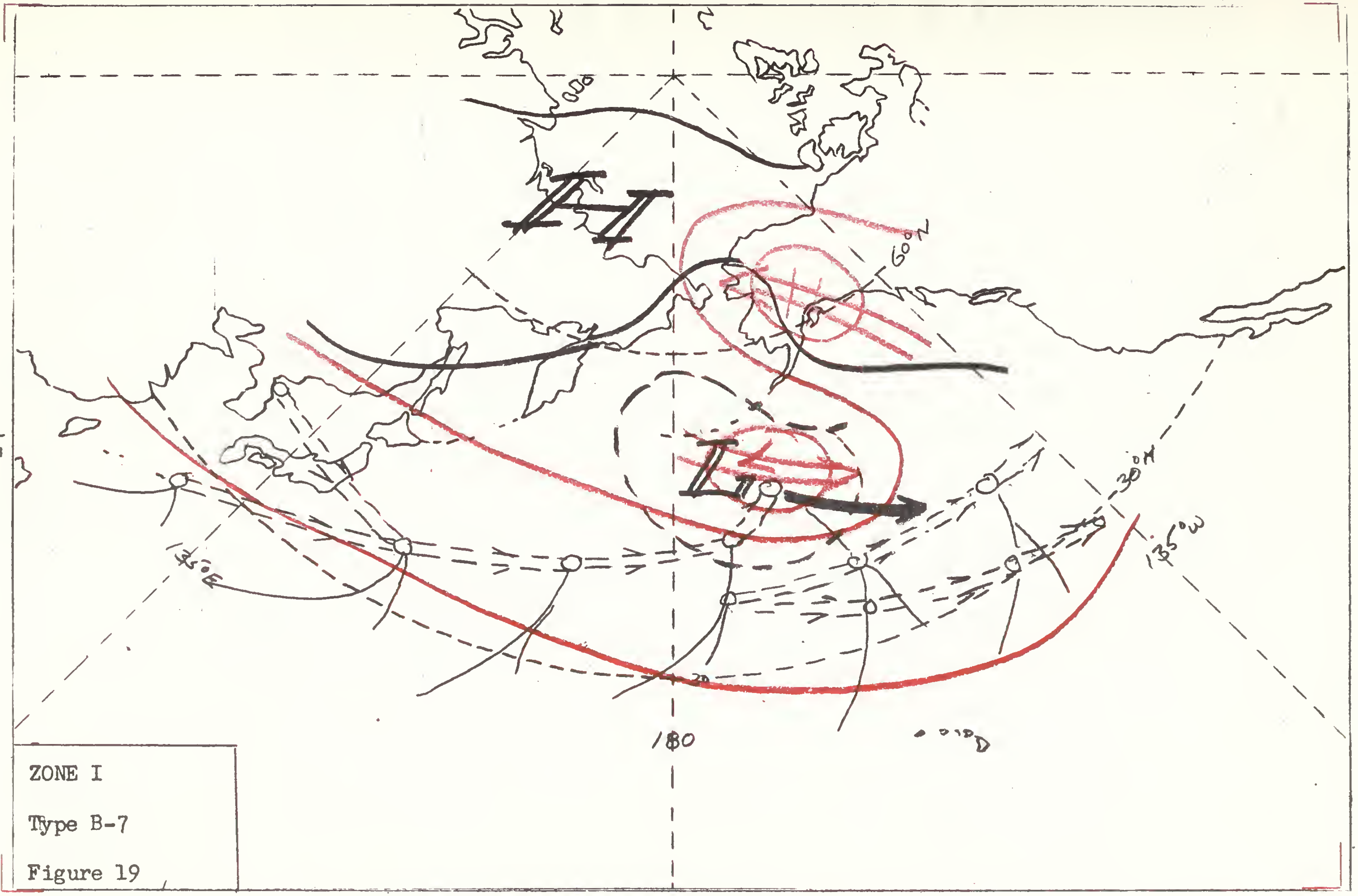
Figure 18

ZONE I Type B-7

At 500-mb a ridge located at 135°W longitude starts to build to the northwest toward Alaska. A closed dynamic high cell soon appears in the ridge and it slowly works to the northwest. A closed cold low center moves to the east south of the High. The 500-mb main current flows zonally across the Pacific from south of Japan to the area north of the Hawaiian Islands. Here it splits, one branch continuing to the east while the other twists around the low center and flows in a northwesterly direction until recurving to the eastward north of the high.

On the surface an area of high pressure covers Alaska and Northeast Siberia. Waves develop on cold fronts moving off the Asian Continent and on the trailing edge of fronts south of Japan. These systems move rapidly eastward occluding in the mid-Pacific. Skagerraking occurs north of the Hawaiian Islands and the new lows are steered eastward under the upper-air flow.

Cyclonic circulation dominates the Central Pacific south of 60°N latitude as successive frontal systems occlude in this area. This area of low pressure extends further to the east with the eastward progress of the cold low.



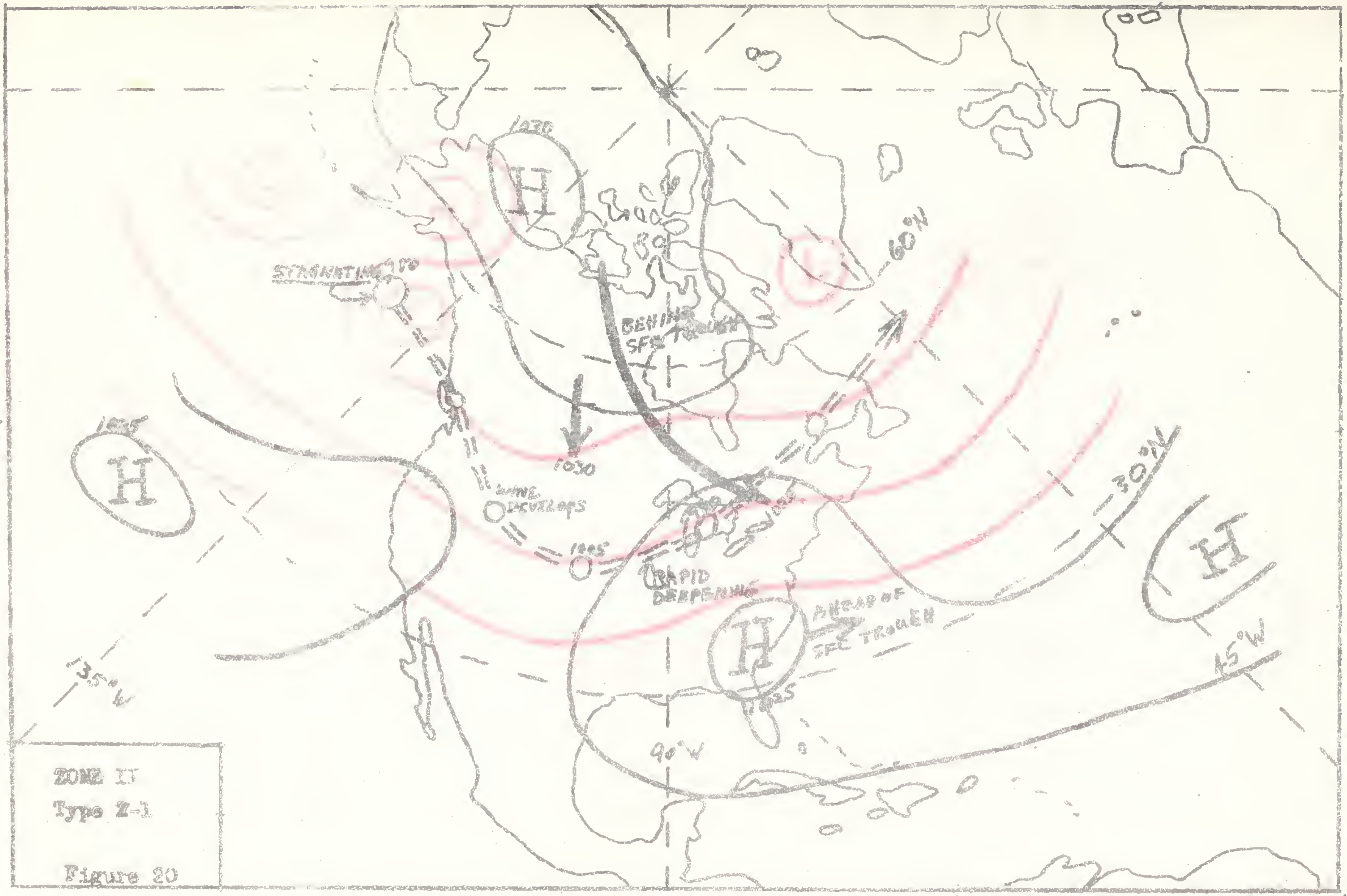
ZONE I

Type B-7

Figure 19

ZONE II Type Z-1

This zonal flow type is characterized by a 500-mb pattern showing only minor troughs and ridges, a closed High poleward of 55°N over the Alaska-Northwest Canada region (during the early stages), and a quasistationary Low off the British Columbia coast. The main current of the 500-mb flow is displaced south of normal over the entire zone and is accompanied by large amounts of cold air in northern regions. At the surface there is present in Alaska and Northwest Canada a persistent, continental high pressure area, while a quasi-stationary Low sits in the Gulf of Alaska. The easterly lobe of the Pacific High is weak and southwest of its normal position. Cyclones approaching the West Coast reach their maximum intensity just offshore at 45° to 50°N, and as the frontal systems move inland across the Rockies, a wave often develops along the frontal zone. This new cyclonic center moves east-southeastward, being continually pressed southward by the mass of cold polar Canadian air to the north, until it reaches the Appalachians. There it deepens rapidly and recurves to the northeast. A moderate polar outbreak usually follows the Low into the Great Lakes and New England regions. Type Z-1 is analogous to Elliott's types Em and/or El and usually lasts about 4 to 6 days.



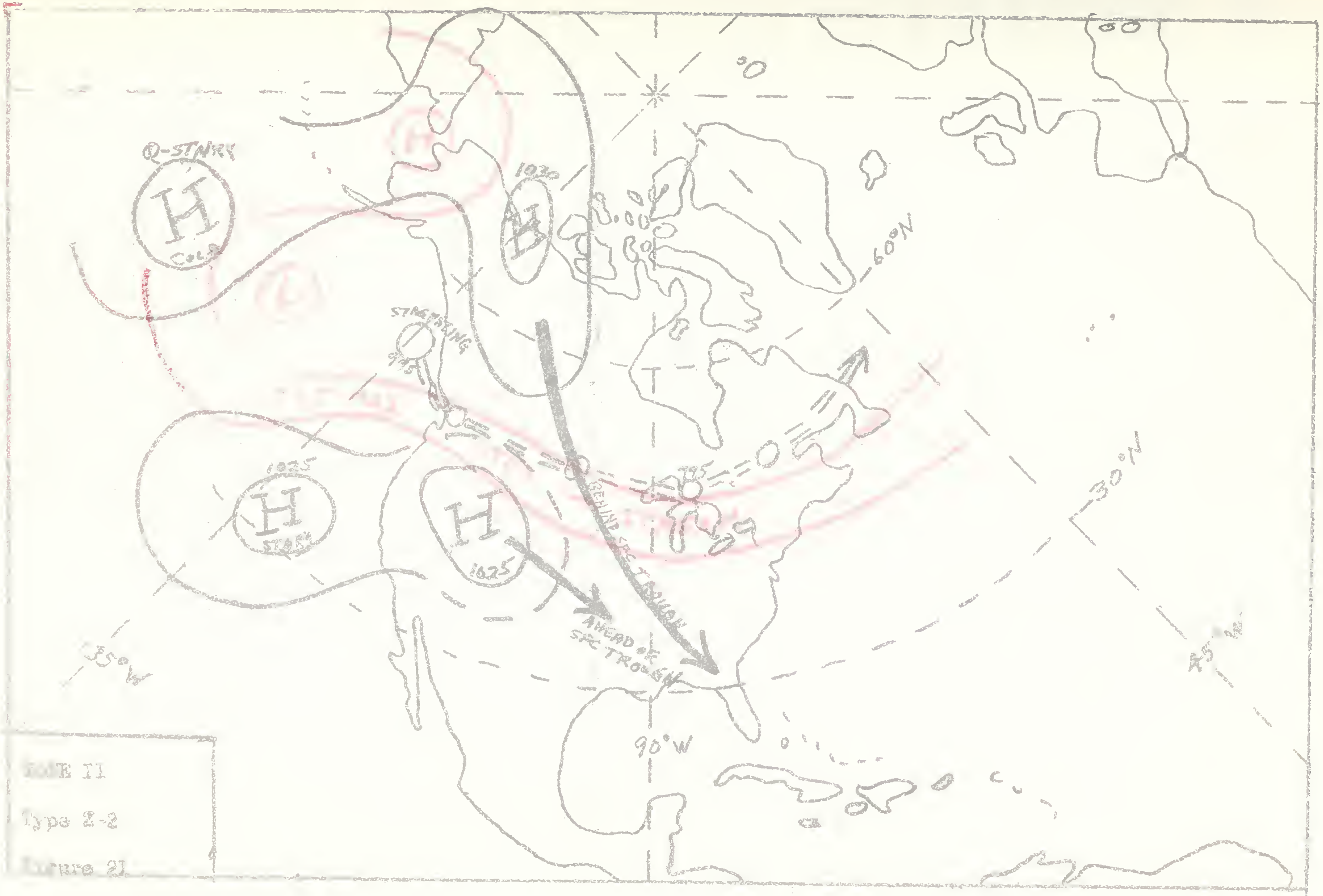
ZONE II
Type Z-1

Figure 20

ZONE II Type Z-2

This is a zonal flow type whose main feature is a strong jet stream at the 500-mb level. This jet has its maximum just off the West Coast and thence follows the 45th parallel across the zone. Overall, the 500-mb pattern is strongly zonal, with a closed High (or Ridge) poleward of 55°N over Northwest Alaska and/or the Bering Sea, and a quasistationary Low in the Gulf of Alaska. At the surface an intense, dynamic High is present in Alaska-Northwest Canada. The easterly lobe of the Pacific High extends to the Great Basin, where a High of moderate intensity persists in the early stages of the type. A surface Low is present off the British Columbia coast, and part of this Low remains stagnant as the main part moves in towards the coast. The cyclonic centers move inland along the narrow jet stream and are steered rapidly eastward across the zone along the 50th parallel. As the major surface trough moves out, the cPk air mass travels southward behind the Low, intensifying along the way. This polar outbreak is very intense and often extends far south into Florida. Type Z-2 corresponds to Elliott's types En and/or Ej[1] and usually persists for 6 to 8 days.

1. Similar to Elliott's B type on the surface, but associated jet stream at 500-mb steers Low centers more rapidly across the zone. Also, an intense polar outbreak occurs with this type.



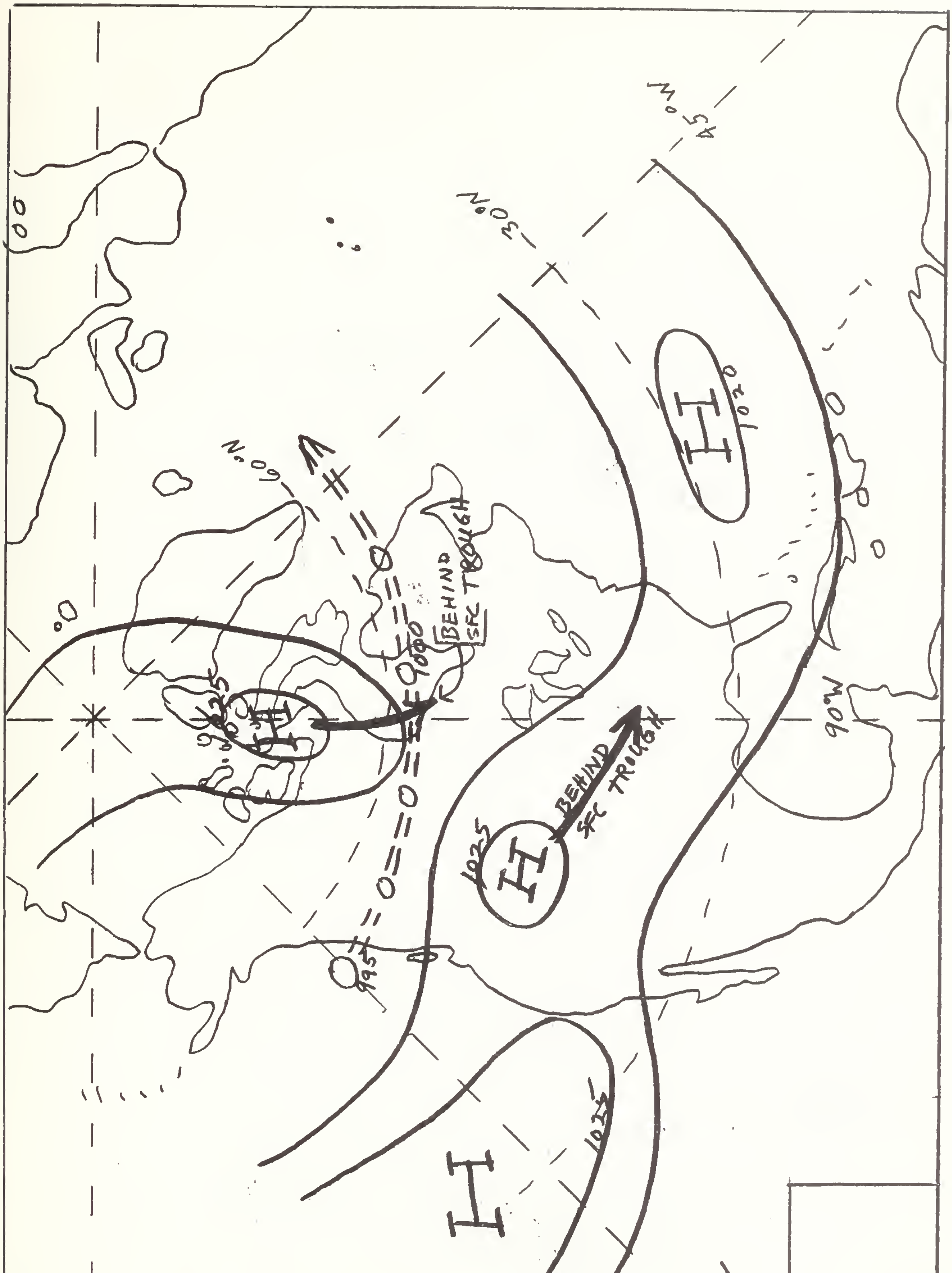
ZONE II

Type 2-2

Figure 21

ZONE II   Type Z-3

This is the zonal flow type whose outstanding feature is purely zonal flow, i.e. The 500-mb level exhibits no remarkable characteristics other than unusually straight flow with no major troughs or ridges. More specifically, the belt of westerlies is slightly north of so-called "normal", and the smooth 500-mb flow is from west to east except for a shallow trough off the West Coast and another in the Eastern United States. On the surface, the high pressure cells are oriented east-west, and there is a mild stagnating Low in the Gulf of Alaska. The Low centers move eastward through Northern Canada following the 55th parallel, with a frontal zone trailing southward from the center across Southern Canada and into the United States. A Great Basin High is present intermittently, each migrating cell being replaced by a new one breaking off from the Pacific cell after passage of the frontal zone. As the Low approaches the Great Lakes area, slight intensification occurs. This type is very stable and will persist until there is a definite change in the 500-mb pattern. Type Z-3 corresponds to Elliott's type B.



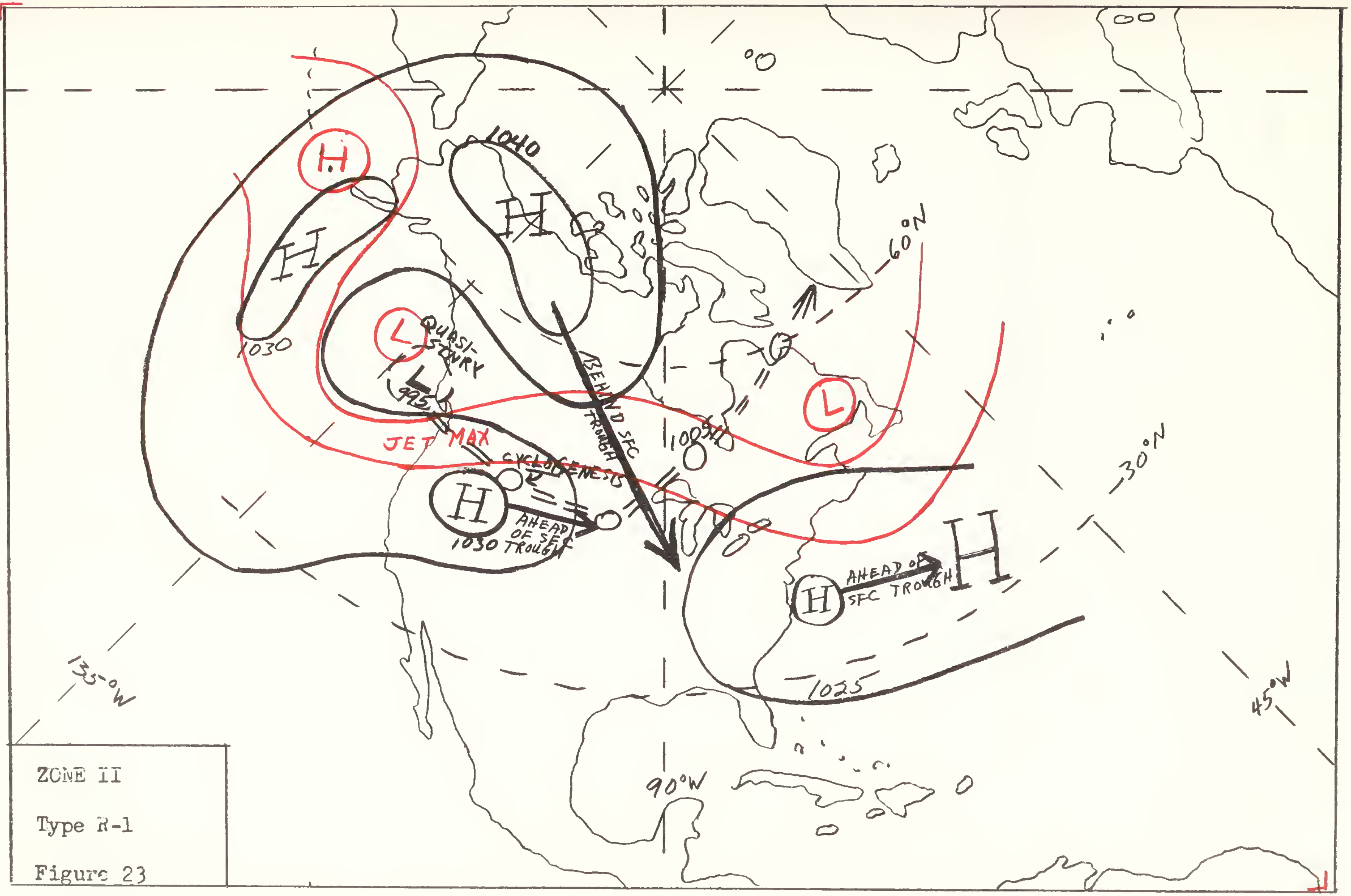
ZONE II

Type Z-3

Figure 22

ZONE II Type R-1

This meridional flow type is characterized by a strong 500-mb ridge near 165°W. A quasistationary 500-mb Low exists off the British Columbia coast during the life history of the type. Over the continent the upper flow is more zonal with a jet stream maximum entering the West Coast at about 45°N and a moderate ridge developing over the middle of the continent during the latter stages. On the surface a large crescent-shaped High extends from the Great Basin out over the Pacific and into Alaska. The warm Pacific cell is north of its normal position, and the cold Great Basin High is rather intense. The Northwest Canada portion of the crescent High is cold, intense, and of polar origin. The frontal systems more eastward from a quasistationary Low center off the British Columbia coast with the Basin High moving out ahead. The frontal zones cross the Rockies to the Montana area, where formation of a new wave occurs. This wave is steered eastward through the North Central United States, and then recurves to the north over the Great Lakes region. The cPk air mass initially centered in Northwest Canada moves south and east behind the Low, weakening slightly along the way, and on occasion extends to the Gulf of Mexico. Type R-1 corresponds to Elliott's type D and usually exhibits a life history of about 5 days.



ZONE II

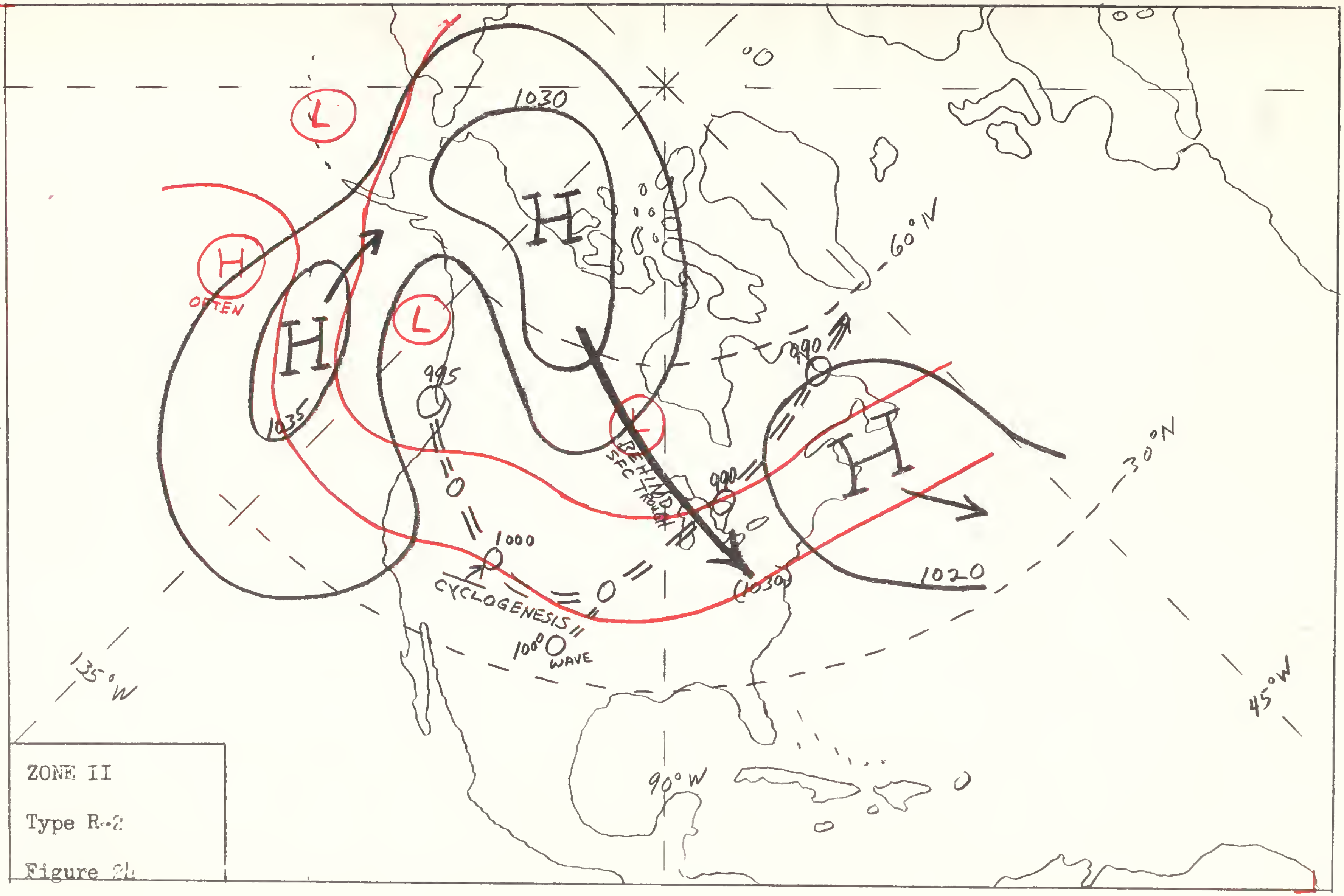
Type R-1

Figure 23

ZONE II Type R-2

This meridional flow type is characterized by a strong 500-mb ridge near 155°W. Two quasistationary Lows are found in the 500-mb pattern, one centered on (or just inland of) the British Columbia coast, and the other in the Hudson Bay region. A slight ridge is initially present between these Lows, increasing in amplitude in the latter stages of the type. Overall, there is strong meridional flow aloft throughout the entire life history of the type. On the surface, the Great Basin High is conspicuous by its absence. The easterly lobe of the Pacific High is unusually strong and northwest of its normal winter position, merging with a cold Alaskan High. Surface waves form along the Southeast Alaskan or British Columbia coast and are steered down the coast into the Great Basin area. As the cyclones cross the Rockies, further intensification occurs, and these storms are then steered northeastward across the Great Lakes and into Canada. The eastern lobe of the Alaskan High forms a new cell which moves south and then eastward behind the Low, producing a moderate polar outbreak in the Great Lakes and New England regions. Type R-2 is analogous to Elliott's types A and/or A_o[1] and usually lasts 4 to 6 days.

1. In the early stages, the closed 500-mb Low off the British Columbia Coast moves south until just off the coast of Central California.



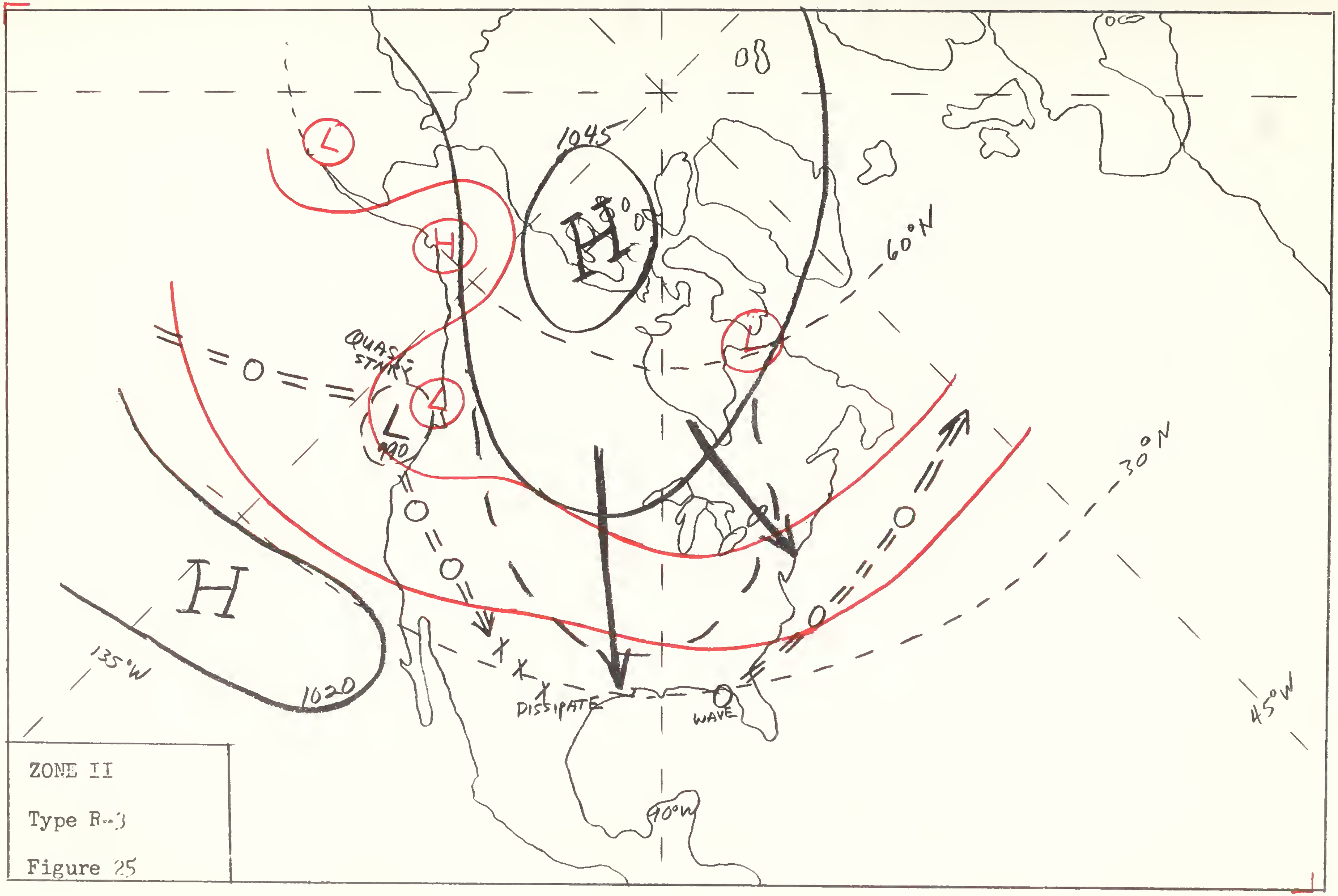
ZONE II

Type R-2

Figure 24

ZONE II Type R-3

This type is the least meridional of all the "R" types, and in fact, Elliott classifies it as zonal. However, due to the presence of the closed High at 500-mb and the magnitude of the polar outbreak accompanying extreme meridional conditions on the surface, it has been classified as meridional. The main current of the 500-mb flow is essentially zonal across the zone and displaced to the south, with a quasistationary Low off the British Columbia coast. A cut-off 500-mb High is found over Alaska, but this High usually breaks down into a ridge over the continent during the latter stages of the type. An intense surface High covers the entire northern regions of the continent with its center in Northwest Canada. This High extends southeast to Central Canada at the start of the type, and then moves southward until it covers the entire continent. The trip takes about three days and the Polar Front is pushed ahead of this wedge. Cyclones entering the West Coast near the Northern California border are steered around the thermal High, forcing the storms southeast to the Great Basin where they stagnate and die. Occasionally, a wave will develop on the trailing Polar Front in the Gulf of Mexico and will travel up the East Coast as a major storm. Type R-3 corresponds to Elliott's type Eh and normally persists for about 5 days.



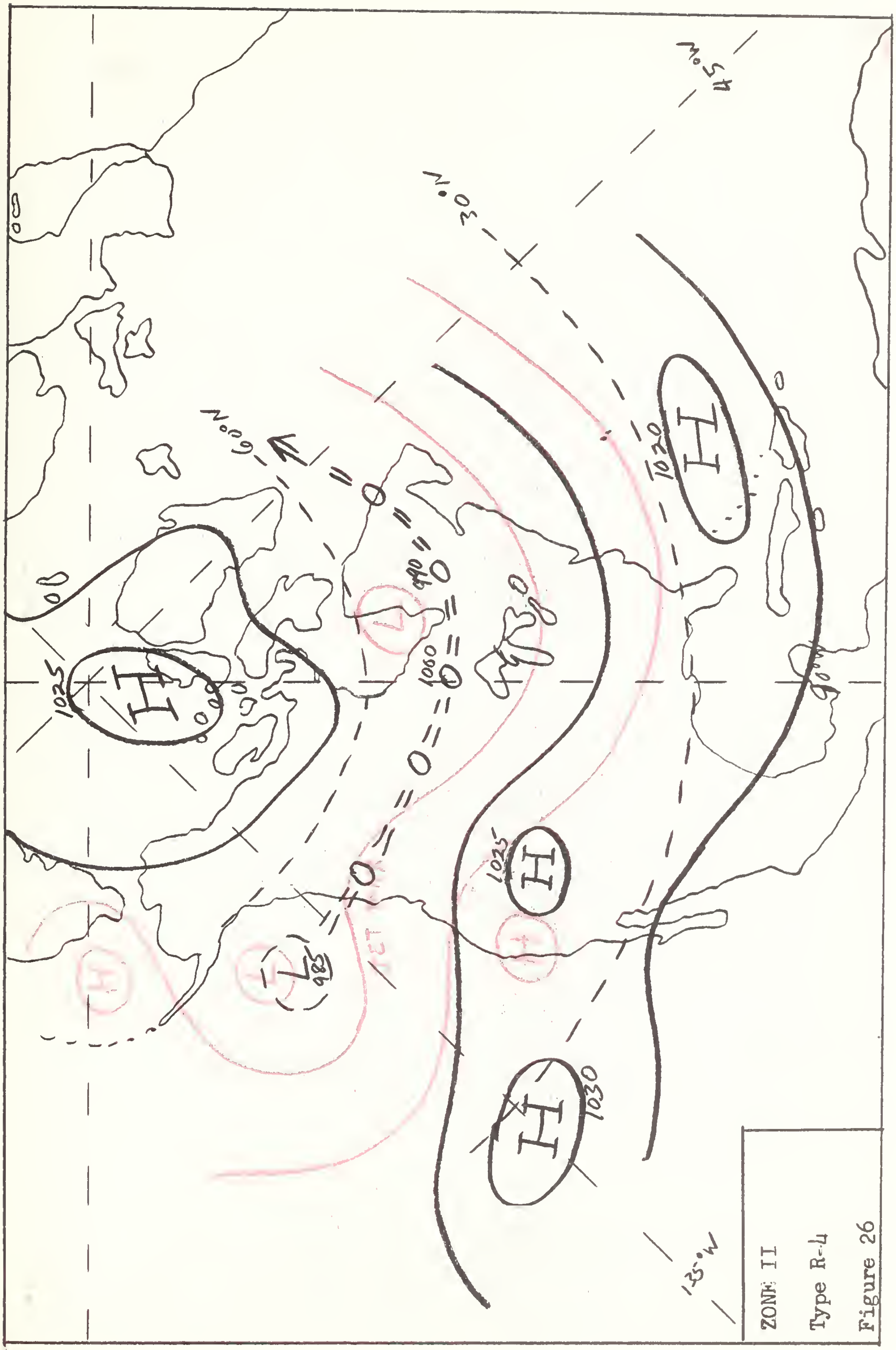
ZONE II

Type R-3

Figure 25

ZONE II Type R-4

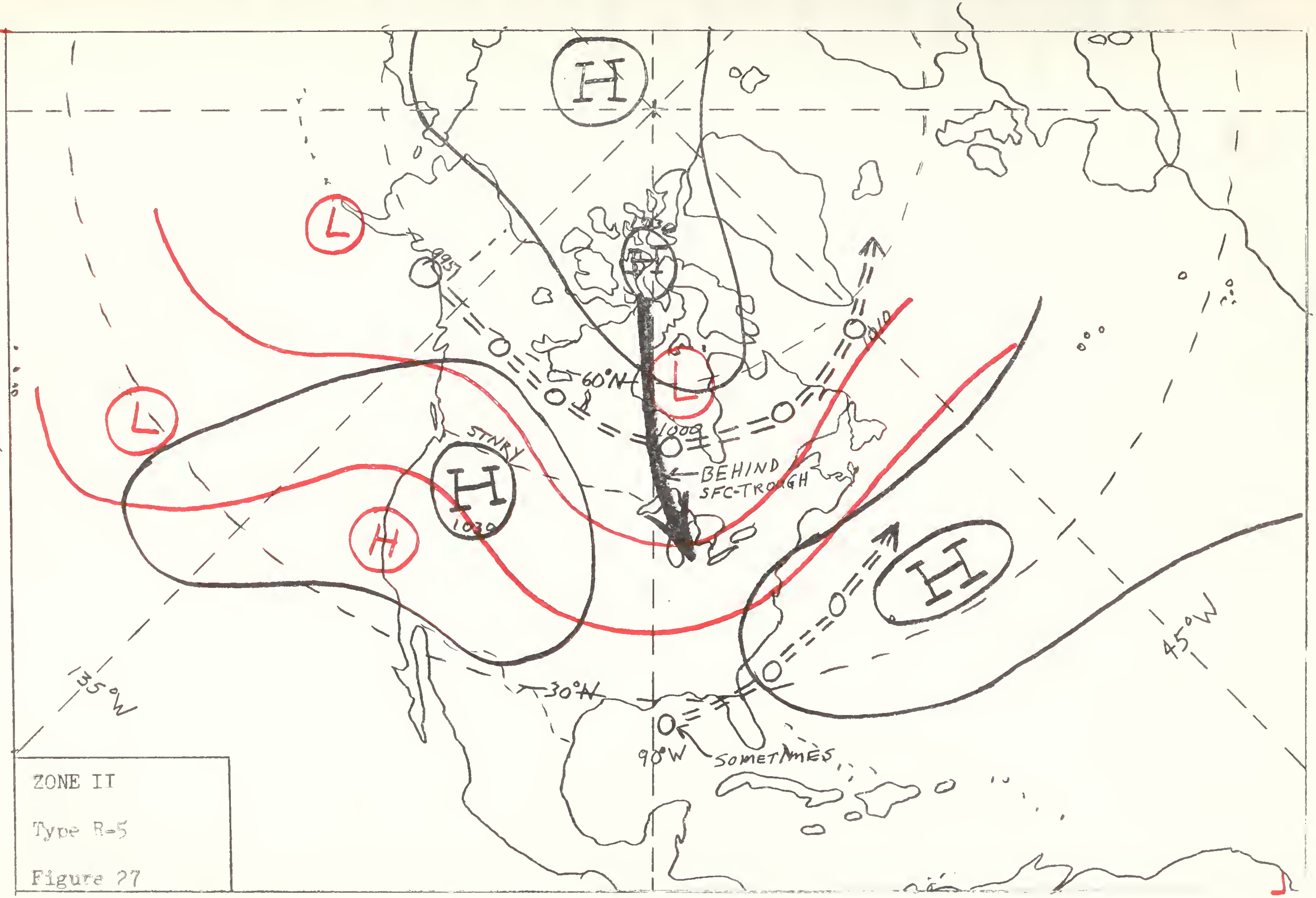
This meridional flow type is associated with a 500-mb jet stream oriented westsouthwest-eastnortheast over the British Columbia coast. Other features of the 500-mb flow are a moderate ridge centered on the 120°W meridian, a quasistationary Low in the Gulf of Alaska, and another in the Hudson Bay region, and sometimes a closed High in Northwest Alaska or the Bering Sea. On the surface a cPk air mass stagnates in Northern Canada during the life of the type, and a quasistationary Low is present in the Gulf of Alaska. The easterly lobe of the Pacific cell is southeast of its normal position and merges with a persistent, dynamic Great Basin High that is small but intense. A wedge of weak high pressure extends across the Southern United States and merges with the Bermuda High in the Atlantic. Small Lows break off from the Aleutian Low and are steered eastward along the 50th parallel by the jet stream aloft. These systems deepen rapidly in the vicinity of the Great Lakes and then recurve to the northeast. This type corresponds to Elliott's type Bs and normally lasts about 5 days.



ZONE II
Type R-4
Figure 26

ZONE II Type R-5

This meridional flow type has rather even flow at the 500-mb level, with a ridge of moderate intensity centered on the 120°W meridian and a Low, with associated trough, in the Hudson Bay region. A quasistationary 500-mb Low is present in the Gulf of Alaska. A persistent dynamic Great Basin High is the dominant feature of the surface pattern. In the initial phases, a cPk air mass is centered in Northwest Canada, and an extension of the Bernuda High is over the eastern seaboard. A quasistationary surface Low in the Gulf of Alaska generates frontal systems which move eastward over the Great Basin High, and thence southeastward after crossing the Rockies. These Lows recurve to the northeast over the Great Lakes region. The cold, Canadian High pushing down behind the Low produces a relatively mild polar outbreak in the Mississippi Valley and eastward. Trailing fronts often develop a wave in the Gulf of Mexico or along the East Coast of the United States which rapidly develops and moves out to the northeast. Type R-5 is analogous to Elliott's types Bn-a and/or Bn and normally lasts about 6 days.



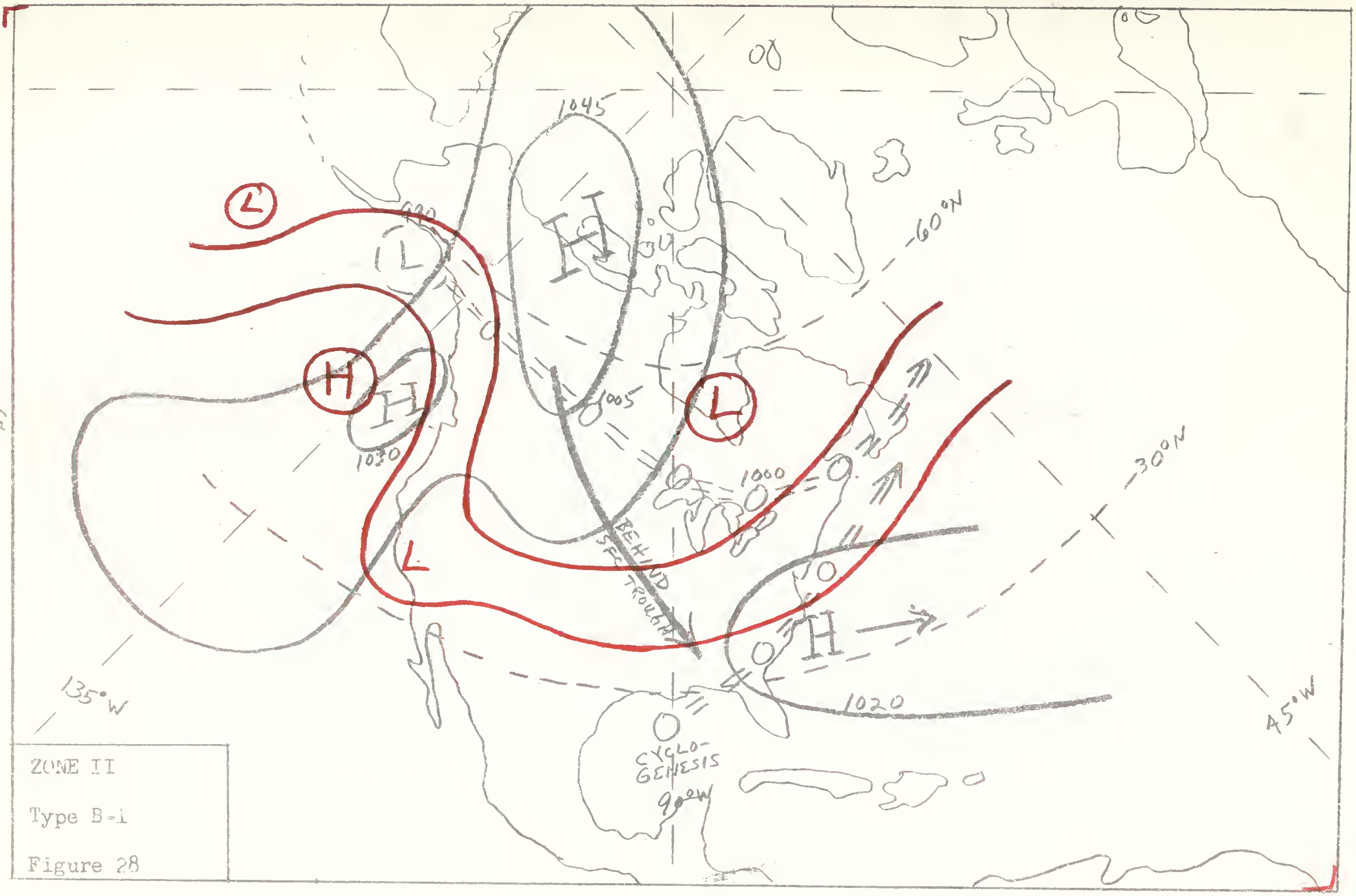
ZONE II

Type R-5

Figure 27

ZONE II Type B-1

In this blocking type the 500-mb flow is dominated by a strong ridge off the West Coast. This ridge contains a closed High poleward of 45°N and often takes the shape of an "omega" block. Sometimes a trapped Low appears south of the closed High, while a broad trough, with associated Lows to the north, covers most of the continent to the east of the block. On the surface, the eastern lobe of the Pacific cell is northeast of its normal position, giving relatively high pressure in the Great Basin. This Pacific High merges with an intense Polar High in Northwest Canada-Alaska to form a strong ridge covering the West Coast from Southern California to the Beaufort Sea. A quasistationary Low in the Gulf of Alaska sends waves in to the British Columbia coast where they are steered southeast by the 500-mb jet coming down the eastern side of the upper-air ridge. This cPk air mass pushes down behind the Low, forcing its track even further south. Deepening occurs in the vicinity of the Great Lakes. Often, a secondary Low develops in Colorado and moves eastward as a major storm. This strong outbreak of cPk air moves south and then southeast behind the Colorado Low. Type B-1 is very common and quite persistent. This type corresponds to Elliott's type Bn-c.



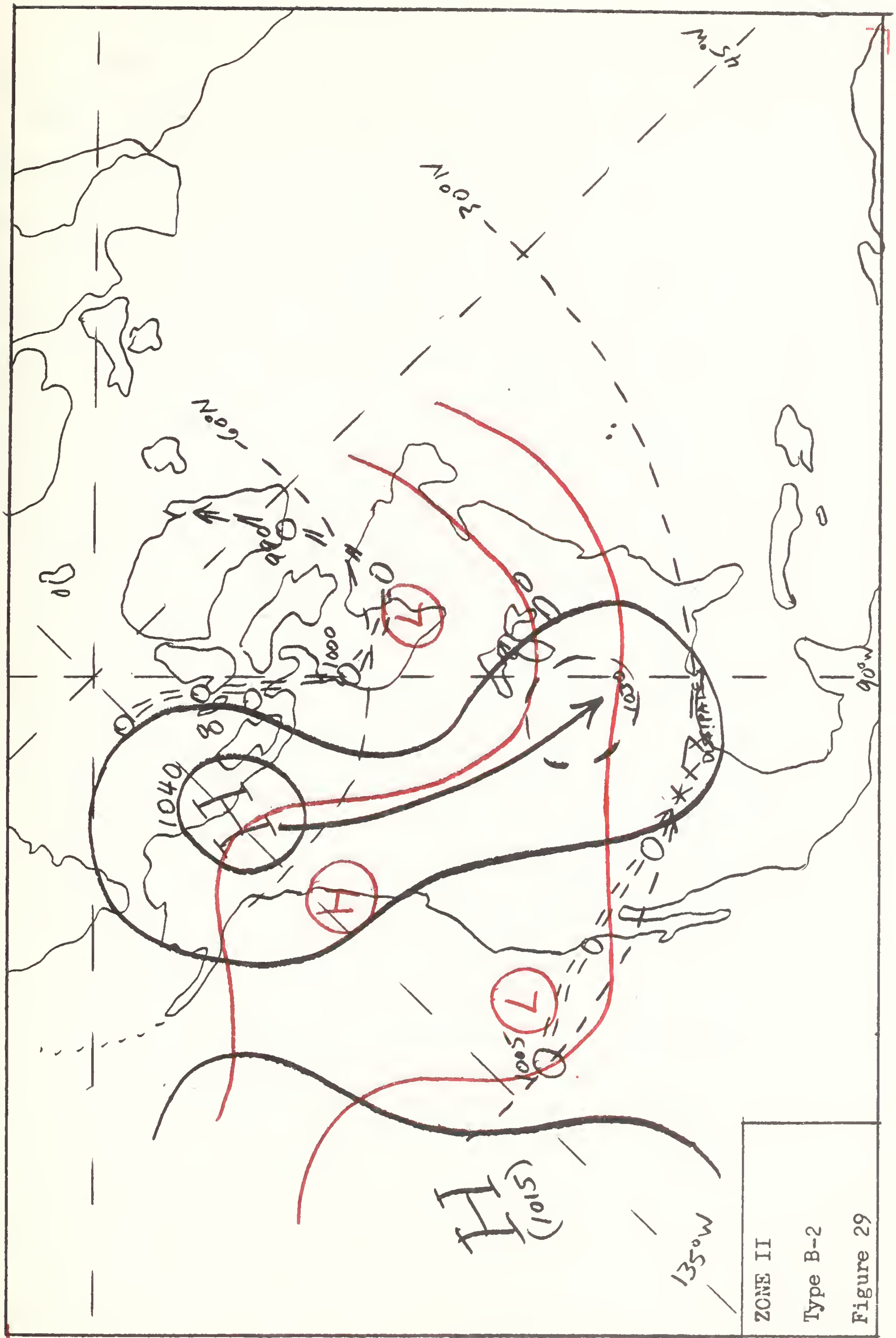
ZONE II

Type B-1

Figure 28

ZONE II   Type B-2

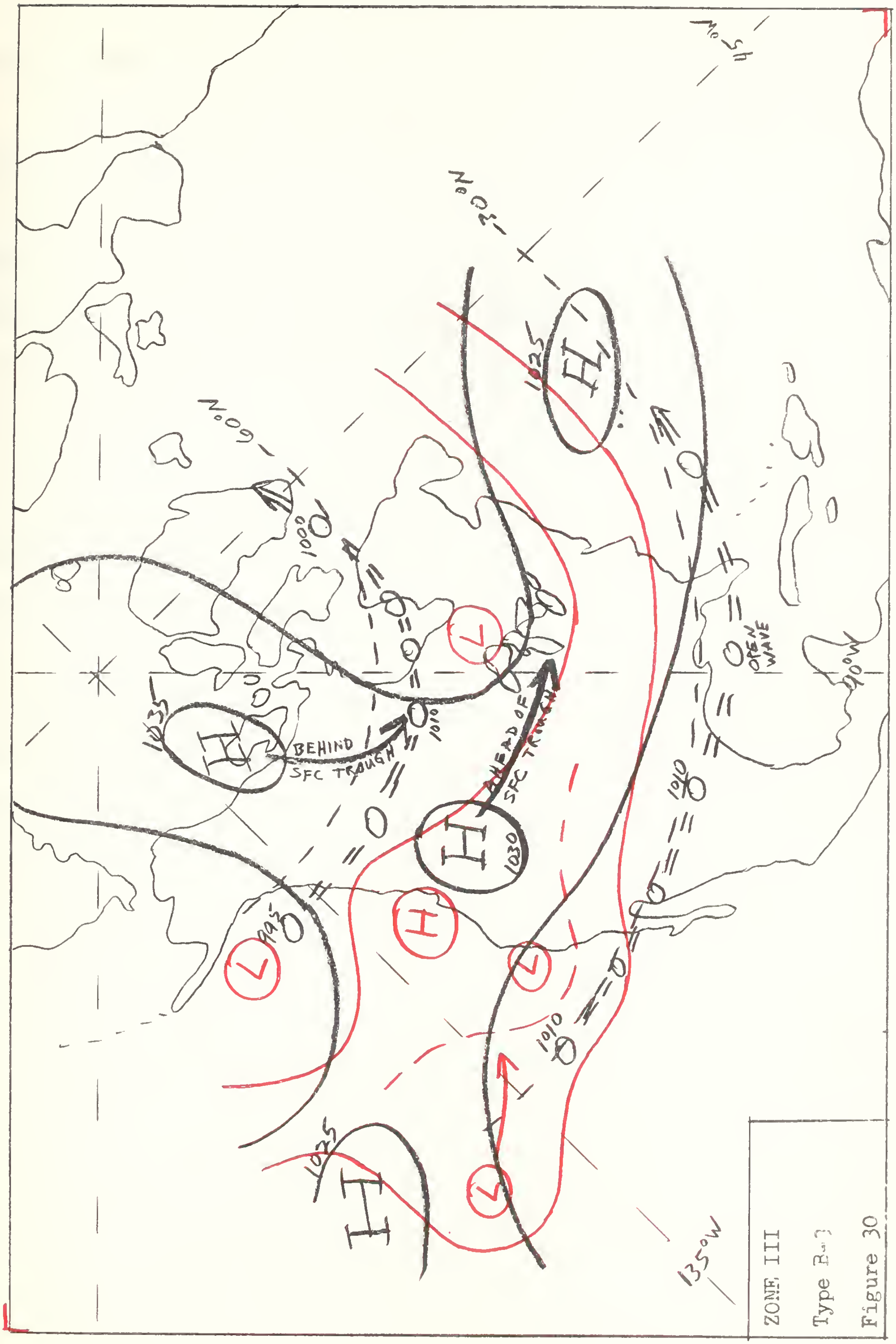
The dominant feature of the 500-mb flow in this blocking type is the split flow over the west coast of the continent and the convergence of this flow downstream. A strong, blocking High is located on the coastline of British Columbia, with a trapped Low directly south just off the coast of Southern California. To the east, a deep 500-mb trough covers the Eastern United States, with a Low over the Hudson Bay area. On the surface, the outstanding feature is a persistent, dynamic High over Northwest Canada. A portion of this cold High breaks off and moves southeastward as a major polar outbreak, traveling through the Great Plains region to the Gulf of Mexico. The magnitude of this outbreak is so great that the cyclonic centers steered into Southern California along the southern storm track are forced to the south and dissipate by the time they reach Eastern New Mexico. The northern storm track is in the Hudson Bay-Quebec region, and the frontal systems associated with these centers trail far south into the eastern United States. Type B-2 corresponds to Elliott's type Ch and, once established, is quite presistent.



ZONE II
Type B-2
Figure 29

ZONE II Type B-3

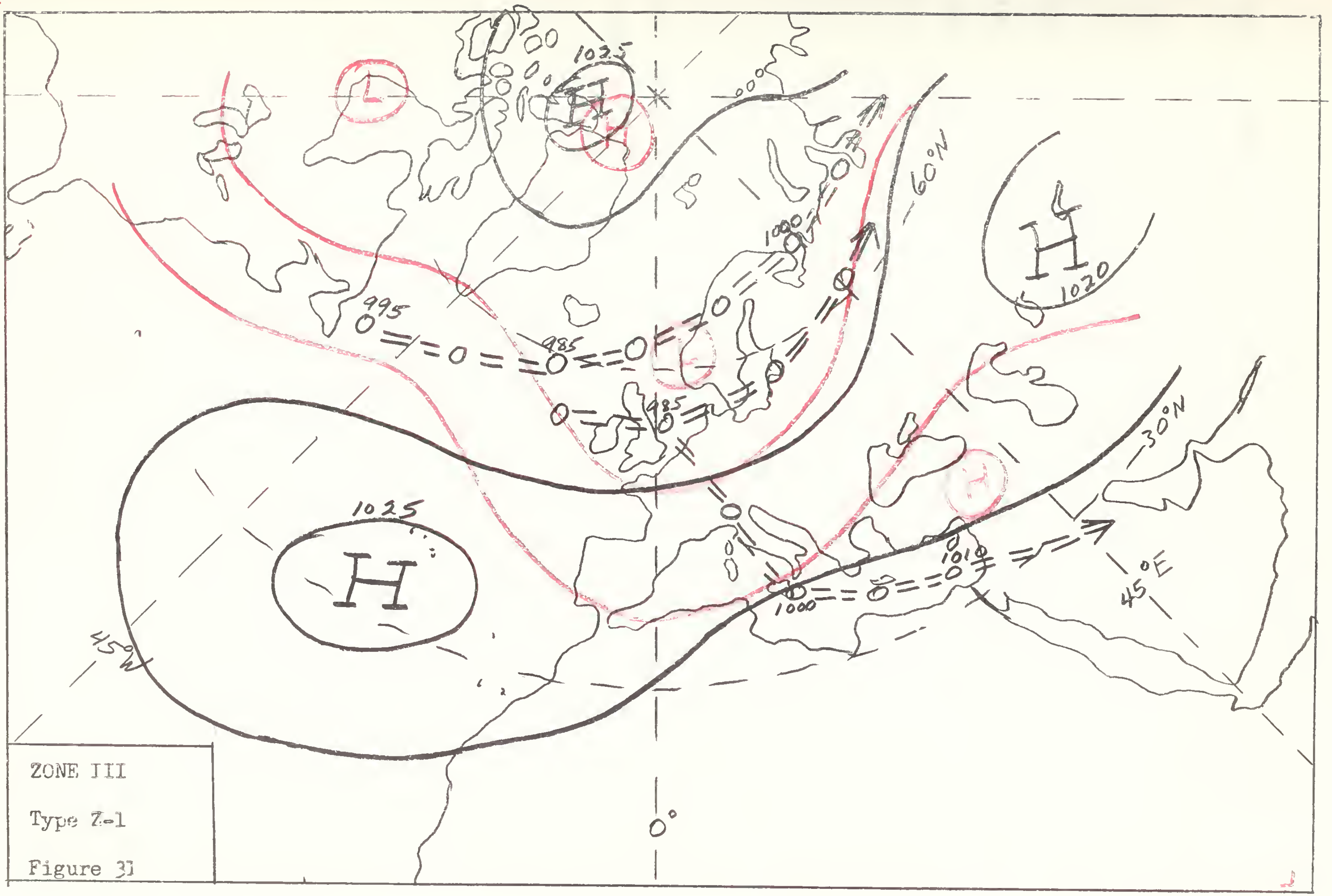
This blocking type exhibits split flow at the 500-mb level with convergence of the flow downstream. A closed 500-mb High is usually present near the Washington coast, with a trapped Low directly south and just off the coast of Central California (sometimes). A trough is located over the Eastern United States with a quasistationary 500-mb Low in the Great Lakes-Hudson Bay region, and another in the Gulf of Alaska. On the surface, a strong, persistent dynamic Great Basin High is located north of its normal position, with an extension to the southwest to the easterly lobe of the Pacific High and another to the east, thereby covering the northern half of the United States with a weak wedge of high pressure. A cPk air mass stagnates in the extreme Northwest portion of Canada during the life history of the type. Two storm tracks are present, one extremely far south and the other just south of the 60th parallel. As the Basin High migrates to the east ahead of a major frontal system extending from the north, another forms to replace it. The track of the northern cyclones is very regular, while the cyclonic centers following the southern track show a very erratic path and usually are identified as open waves by the time they reach the Gulf of Mexico. Type B-3 is similar to B-2, with the primary difference being in the intensity of the centers of action. This type is analogous to Elliott's type C1 and, like all blocking types, is very persistent.



ZONE III
Type B-3
Figure 30

ZONE III Type Z-1

This zonal flow type shows the main current of the 500-mb flow displaced south of normal with a slight ridge in the middle of the North Atlantic and a high latitude block (closed High) over Northern Greenland. Sometimes a closed 500-mb High will be found at the eastern edge of the Mediterranean around 35°N, and one quasistationary Low is usually seen over England-Norway. On the surface, the Azores High is elongated in a westsouthwest-eastnortheast direction with an extension across the Mediterranean and Southern Europe into Russia where it merges with the Russian cell. The dynamic Greenland High is strong, but stable, in its normal northerly position. The cyclones commence their path across the North Atlantic off the coast of Labrador and follow a northnortheasterly track with the centers passing just to the north of the British Isles and then on towards the northern coast of Russia. This activity across the Atlantic is very intense, with the Lows deepening as they approach Iceland. Often, a small wave will break away from the major cyclone over England and travel southeastward to the Mediterranean where it deepens rapidly and recurves to the east. Once this path to the Mediterranean has been established, other waves follow in rapid succession, thereby giving intense cyclonic activity in this region. Type Z-1 is the most southerly of the Zonal flow types and corresponds fairly well to Baur's Type II. This type usually persists for about 4 days.



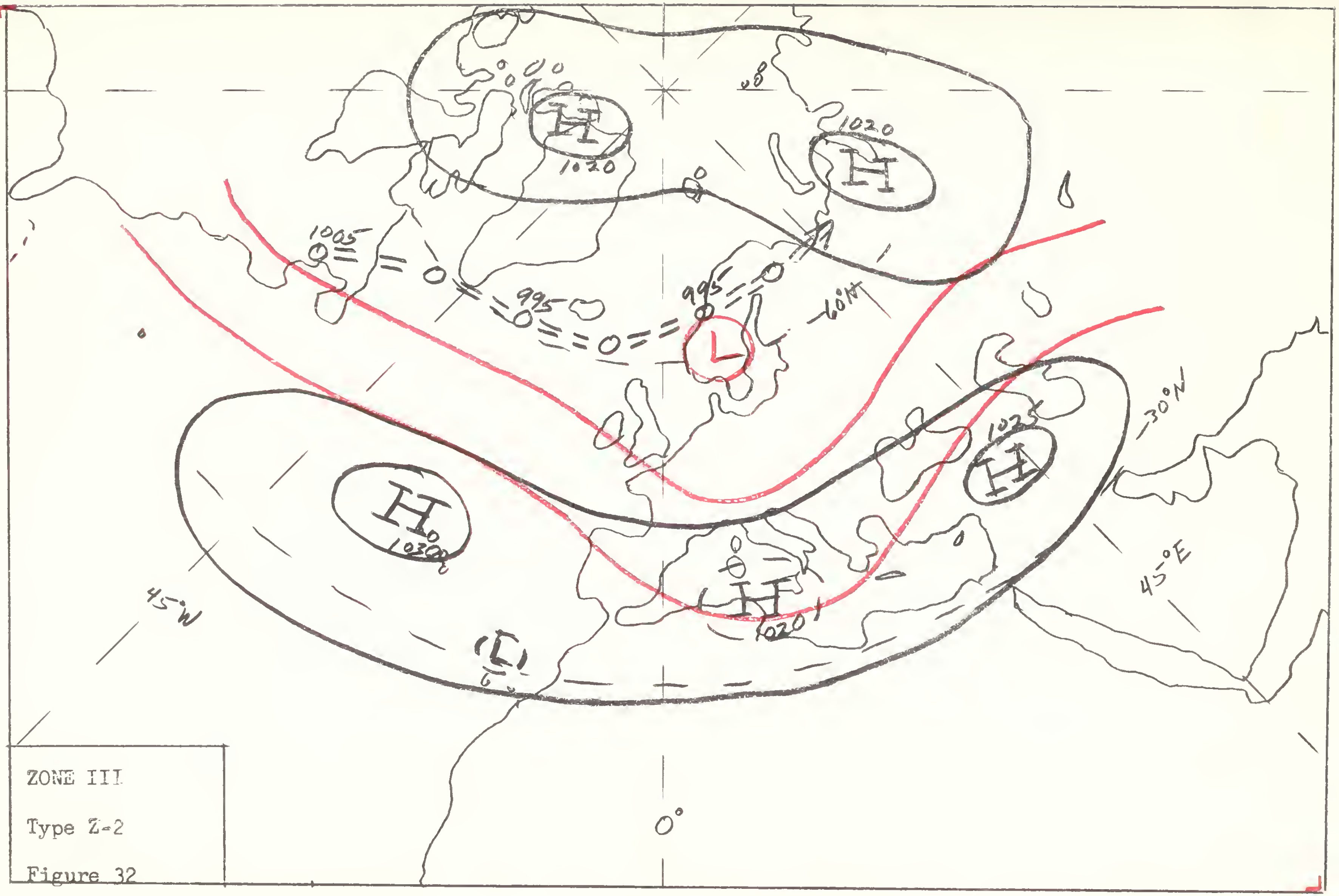
ZONE III

Type Z-1

Figure 31

ZONE III Type Z-2

This is the basic zonal type of Zone III. The 500-mb flow is predominantly zonal throughout the entire zone with one quasistationary Low (around 60°N) over Scandinavia. On the surface, migrating thermal Highs move very slowly from west to east across the zone, with their centers moving along the 40th parallel. This gives, in essence, a belt of high pressure extending from the flattened Azores cell in the west, across the Mediterranean and into Southern Russia and the Near East. The stationary thermal Greenland High ridges down into Northern Russia to join with the Siberian High. Cyclonic activity within the zone is of moderate intensity with a series of depressions moving east from the Newfoundland coast across the southern tip of Greenland, Iceland, and then into Northern Scandinavia. This track follows roughly the 60th parallel. Type Z-2 is very stable and will persist until the index cycle tends towards lower values. This type corresponds very well to Baur's Type I.



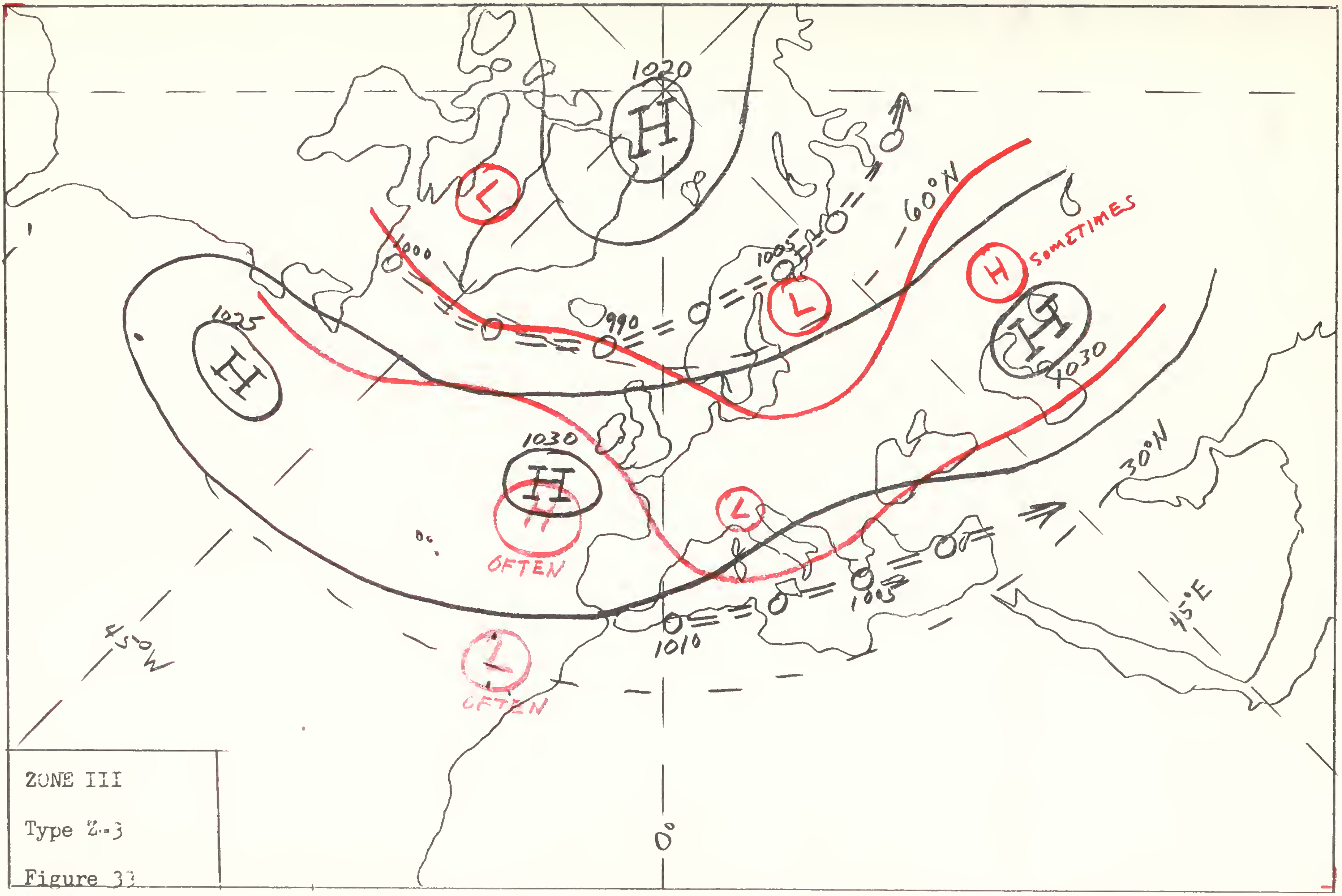
ZONE III

Type Z-2

Figure 32

ZONE III Type Z-3

This is the most meridional of the zonal flow types and also the most northerly. There are usually two closed Highs present in the 500-mb flow, one just off the west coast of Portugal and the other northeast of the Caspian Sea. Of the two, the former is the most common. A quasistationary upper-air Low persists over Scandinavia and sometimes a closed Low will appear in the associated trough over Southern Europe. Weak, cut-off Lows often form in the Atlantic off the North African coast and slowly migrate eastward across the zone. On the surface this type is characterized by a belt of well developed dynamic Highs extending from the east coast of the U.S. to Southeast Russia. The dynamic Azores High is intense and displaced to the northeast, producing an extension onto the continent that is oriented westsouthwest-eastnortheast. Low pressure centers leaving the coast of Labrador travel rapidly and take a far northerly track across the North Atlantic to the northern tip of Norway. These storms usually deepen somewhat in the vicinity of Iceland. In the Western Mediterranean there is an area of moderate cyclogenesis which generates open waves that move due eastward out of the zone. This type is analogous to Baur's Type III and is quite persistent.



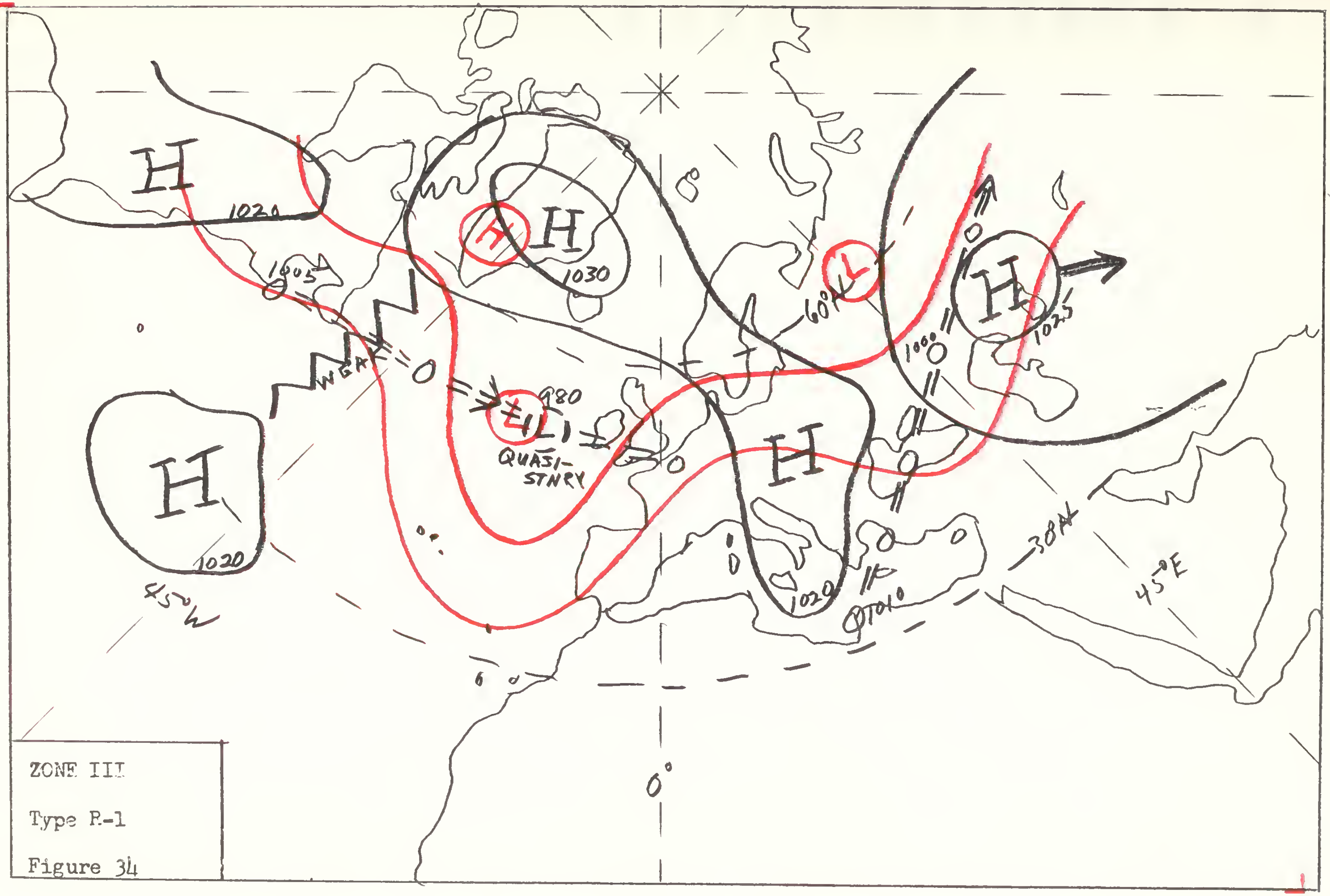
ZONE III

Type Z-3

Figure 33

ZONE III Type R-1

This meridional flow type has a well developed long-wave pattern in the 500-mb flow. Two ridges are present, one in the western North Atlantic, and the other over Central Europe. The amplitude of these ridges is intensified by a deep quasistationary 500-mb Low (with associated trough extending extremely far south) just west of the British Isles. Another upper-air Low is usually present over northern Russia, and sometimes a cut-off 500-mb High will appear north of the ridge in the west. The surface pattern shows a weak ridge in the Western Atlantic extending northward from a weak, southwesterly displaced Azores cell to a strong, southerly-displaced, dynamic Greenland High. The Greenland High also has a southeastward extension which blankets Central Europe with relatively high pressure. A cAk Russian air mass is present in the early stages, but slowly migrates southeastward as the type progresses. The dominant feature of the cyclonic circulation is a deep, quasistationary Low just off the west coast of Ireland. Cyclonic centers leaving the northeast U.S. break across the weak ridge in the Atlantic and feed into this Low, thereby seeming to aid in the continuance of the extremely low pressure. Sometimes a small wave breaks away from this Low and, steered eastward by the current aloft, it moves onto the continent and dissipates near the coast. With this type, waves often form in the Eastern Mediterranean and, slowly deepening, move northeastward into Central Russia. This type usually lasts only 3 or 4 days.



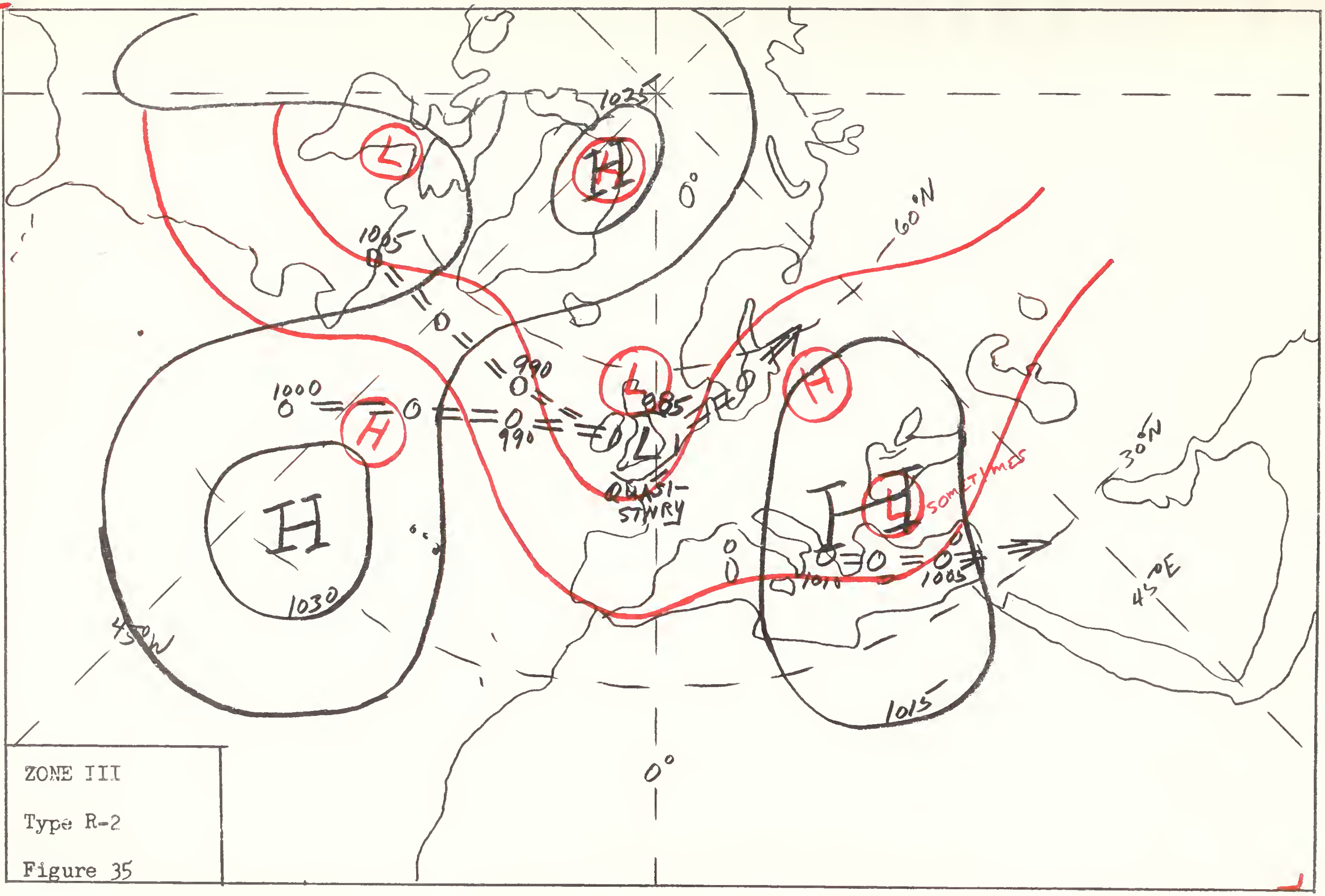
ZONE III

Type R-1

Figure 34

ZONE III Type R-2

The most prominent 500-mb ridge in this type is located about 40°W in the mid-North Atlantic while another ridge sits over Eastern Europe. Both crests often exhibit closed Highs which are not necessarily associated with the surface centers. The eastern system will sometimes have a trapped Low south of the High producing split flow with this very mild "block", while the western ridge usually shows a cut-off High over Greenland far to the north of the crest. On the surface a strong ridge connects the Greenland High with a dynamic Azores High and is centered along the 40°W meridian. A cPk Russian cell of relatively high pressure covers Central and Southern Europe. A deep quasistationary low pressure area persists over England throughout the life history of the type, being reinforced from time to time by weak cyclonic systems from Labrador and the Bermuda area which jump across the ridge in the Atlantic. Frontal systems spin around this deep Low and are then steered on to Southern Scandinavia and Northern Russia where they rapidly dissipate. Cyclogenesis in the Mediterranean occurs east of Italy at frequent intervals, and these storms deepen slightly as they move southeastward out of the zone. Type R-2 is the "standard" meridional type in the zone and is both relatively common and persistent.



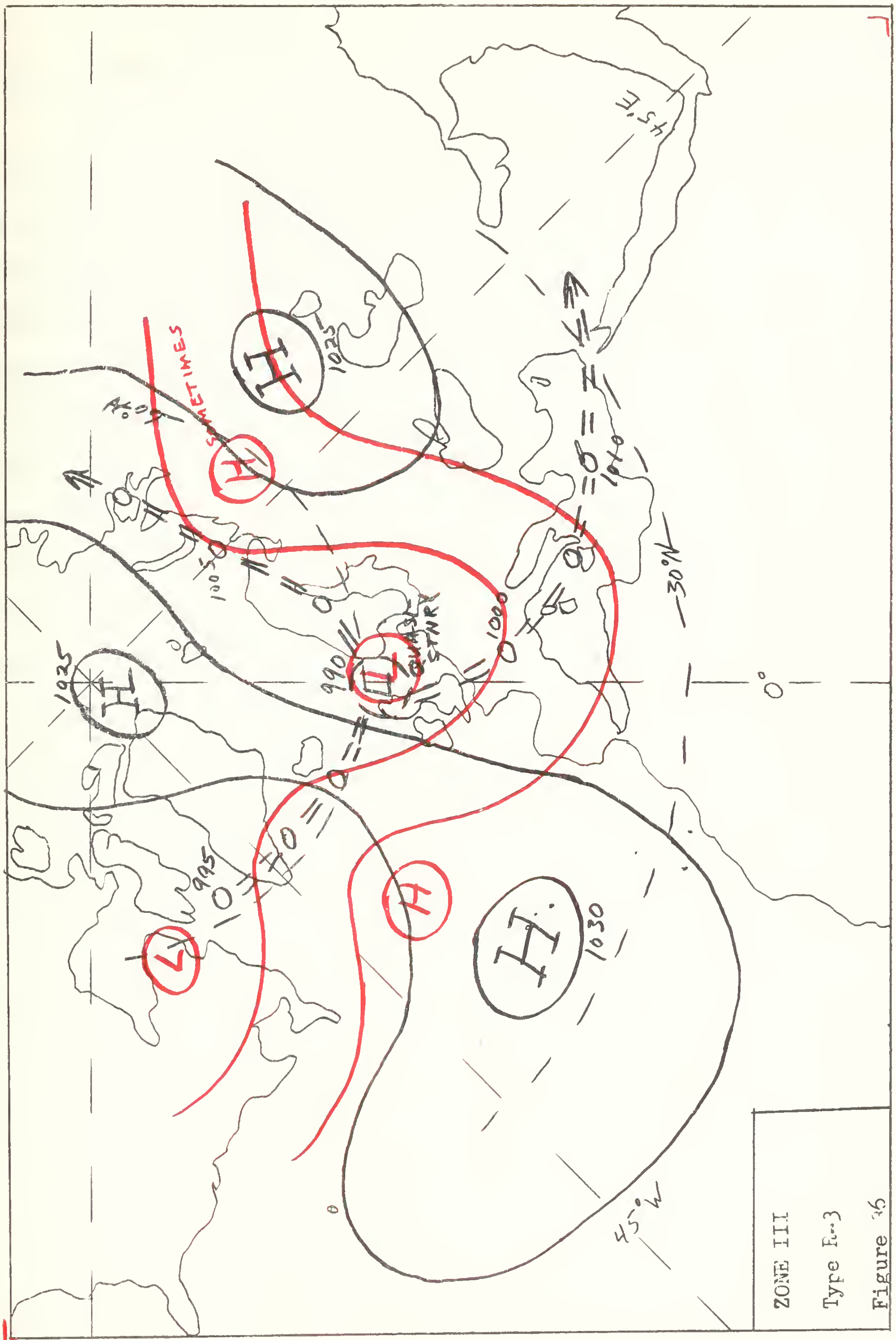
ZONE III

Type R-2

Figure 35

ZONE III   Type R-3

The 500-mb flow in this meridional type is character-ized by two ridges separated by a deep trough. The main ridge is oriented along the 35°W meridian and often has a closed High associated with it (but not necessarily associated with the surface High) while the second ridge is at the eastern limit of the zone and seldom has a closed High to the south. A deep quasistationary 500-mb Low and associated trough is located over lower Scandinavia and Central Europe. On the surface, the dominant feature is a ridge of high pressure over the eastern North Atlantic extending from a strong, dynamic Azores cell to the Greenland High. Cyclonic systems leaving the Northern Labrador coast travel along the 60°N parallel until they reach the British Isles where their centers are absorbed in a deep quasistationary Low at that position. The frontal systems from these cyclones are steered far north or south around the Russian High. Some travel northeast across Scandinavia to Northern Siberia, while other systems are steered south and then east across the Mediterranean. The storms crossing the Mediterranean are usually very intense, deepening somewhat under the maritime influence. This type is comparatively rare and usually lasts about 3 to 4 days.



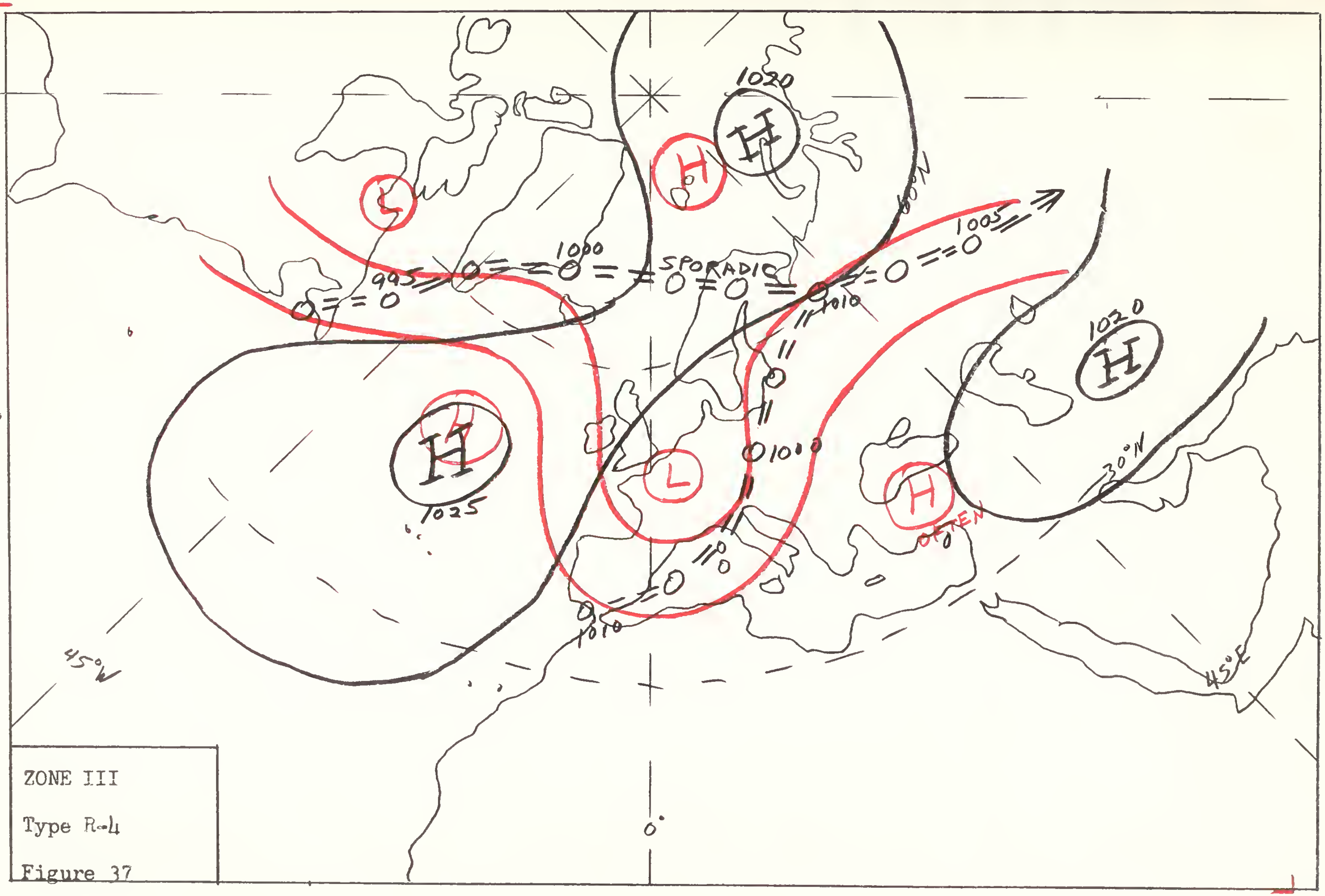
ZONE III

Type E-3

Figure 36

ZONE III   Type R-4

The upper-air flow in this meridional type is characterized by a strong 500-mb ridge west of the British Isles with a southsouthwest-northnortheast tilt to its major axis. A closed High is usually present in the ridge to the south, with a cut-off High over Spitzbergen to the north. A somewhat weaker crest is located over Eastern Europe and Russia, often with a closed High in the region south of the Caspian Sea. Between these two 500-mb crests is a deep Low with an associated trough extending far south to North Africa. On the surface, the dominant high pressure area is a strong ridge extending northnortheastward from the dynamic Azores cell to an Arctic High that has its center in the vicinity of Novaya Zemlya. A weak Russian High is present and displaced south of normal. Deep cyclones leaving the Southern Labrador coast fill slowly as they travel northnortheastward across Greenland and north of Iceland, and then sporadically they break across the ridge and move down into Central Russia. Little deepening occurs anywhere along this track. Waves developing off the coast of Morroco are steered northnortheastward through Central Europe and up into Northern Russia. Again, these storms are not very intense. The life history of this type is normally about 4 days.



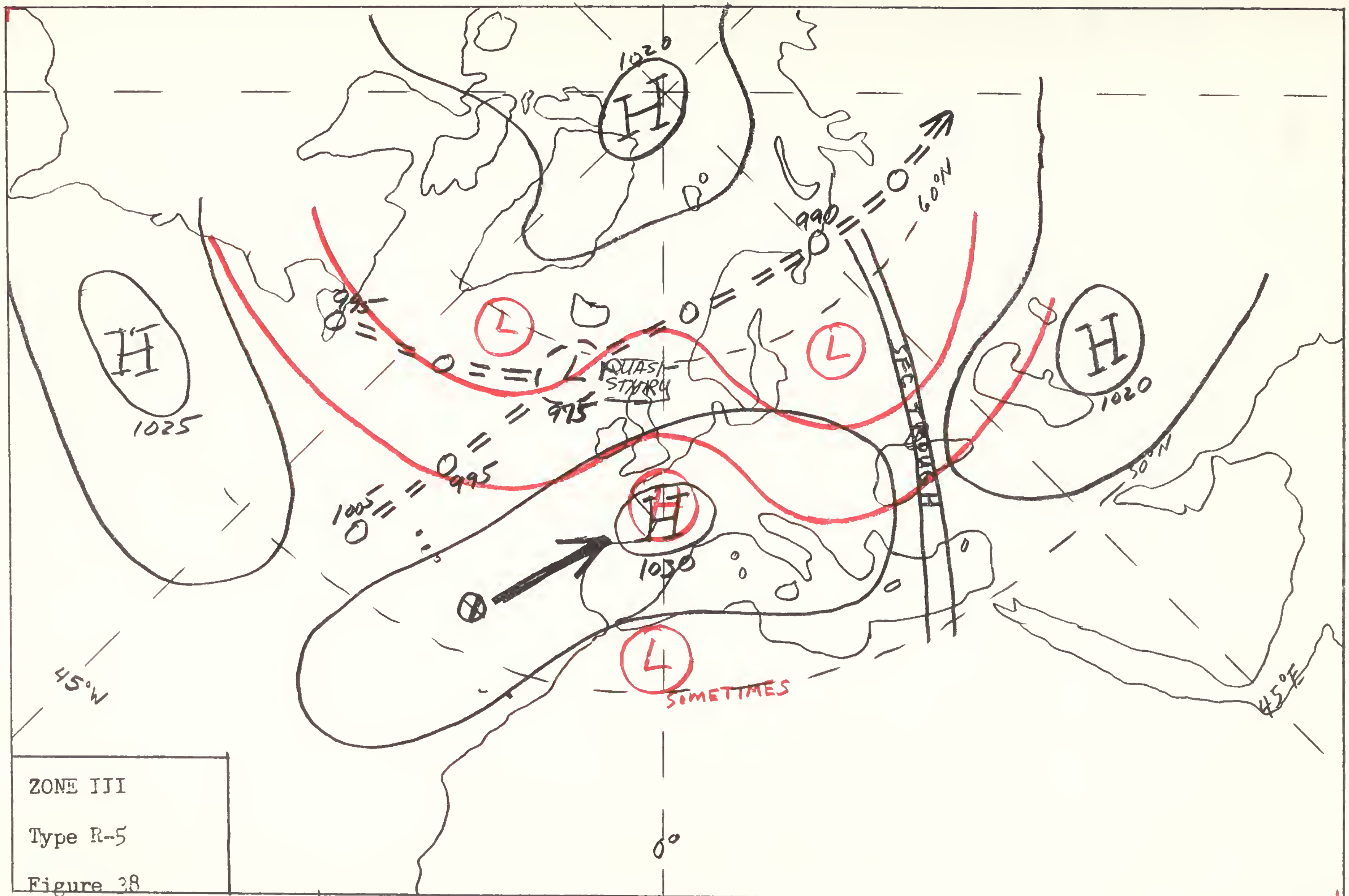
ZONE III

Type R-4

Figure 37

ZONE III Type R-5

The 500-mb flow in this meridional type exhibits a strong ridge on or near the Greenwich meridian, often with a closed High to the south over France. A trapped Low is sometimes found south of the 500-mb High, but this is a migrating type. On the surface, the intense, dynamic Azores High has migrated northeastward onto the continent until its center is over France. The major axis maintains a southwest-northeast tilt throughout the type. Also present in the zone is the Greenland High in its usual northerly position (stagnant), and a southerly displaced Russian High. Intense cyclones cross the Atlantic from the Labrador coast and feed into a deep, quasistationary Low west of Ireland, and then travel northeastward across Northern Scandinavia to the Northern Russian coast. The Ireland Low also receives storms that are generated south of the Azores and steered northward. Throughout the life history of the type, a quasistationary surface trough extends from Novaya Zemlya to the Eastern Mediterranean. Cyclonic activity in the Mediterranean is very rare with this type. Type R-5 is very common in the spring and summer and usually persists for 6 or 7 days.



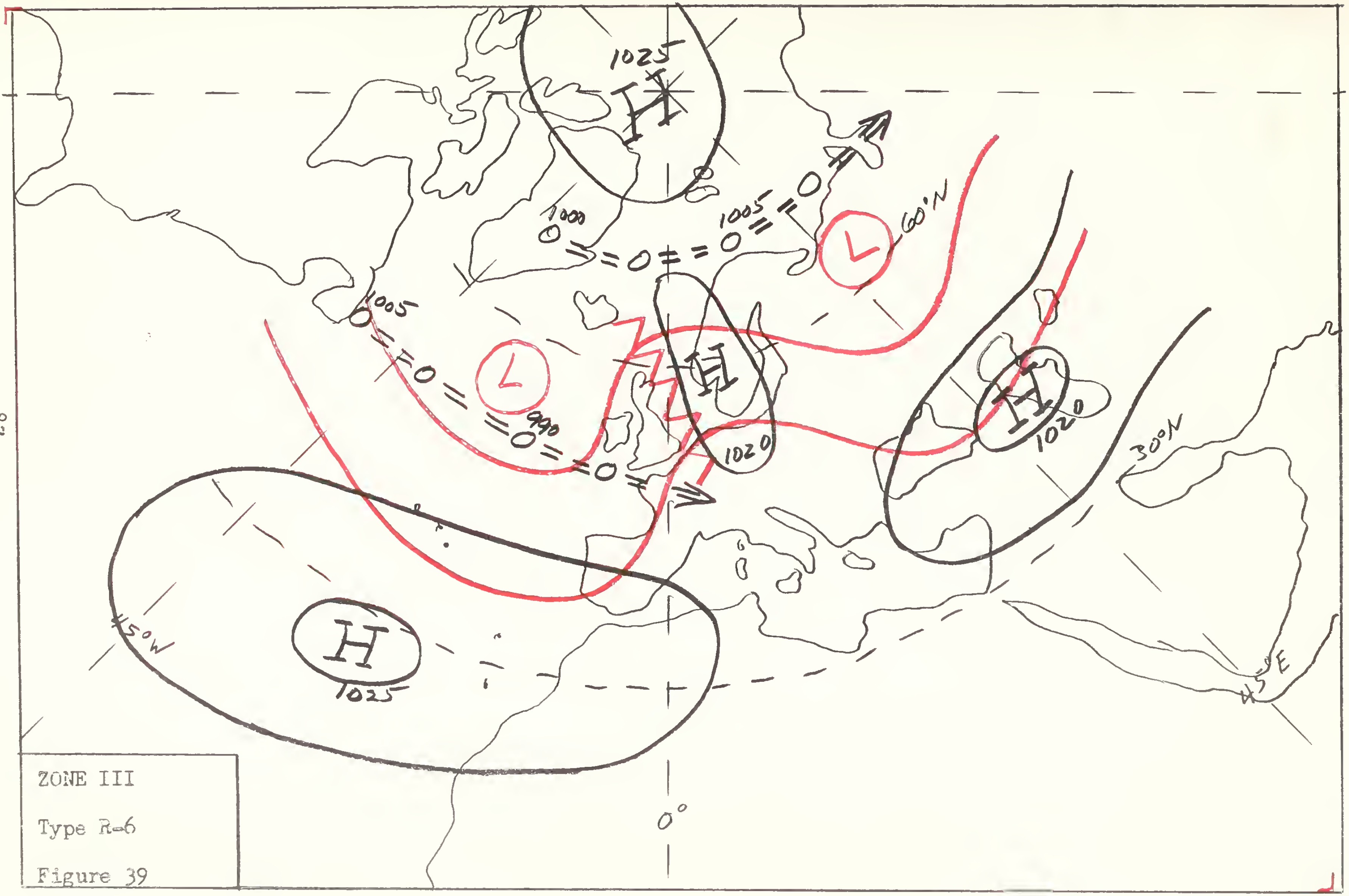
ZONE III

Type R-5

Figure 28

ZONE III Type R-6

This meridional flow type is of a transitory nature. The 500-mb pattern shows a ridge just east of the British Isles with a southsoutheast-northnorthwest tilt to its major axis and two Lows spaced about 75° of longitude apart, one in mid-Atlantic, and the other on the eastern limit of the zone. On the surface, a weak ridge or bubble High is stationed over Southern Norway and is elongated N-S. The thermal Azores cell is flat and south of normal, as is the Russian High. Intense cyclones move zonally across the North Atlantic and pile up near the British Isles, with a few weak systems finding their way into the Mediterranean. This ridge is only strong enough to prevent the cyclones from breaking across for a short period, usually about three or four days. However, the type is common enough to be included as a separate type in the catalogue. This type is usually found in the transition between meridional and zonal flow.



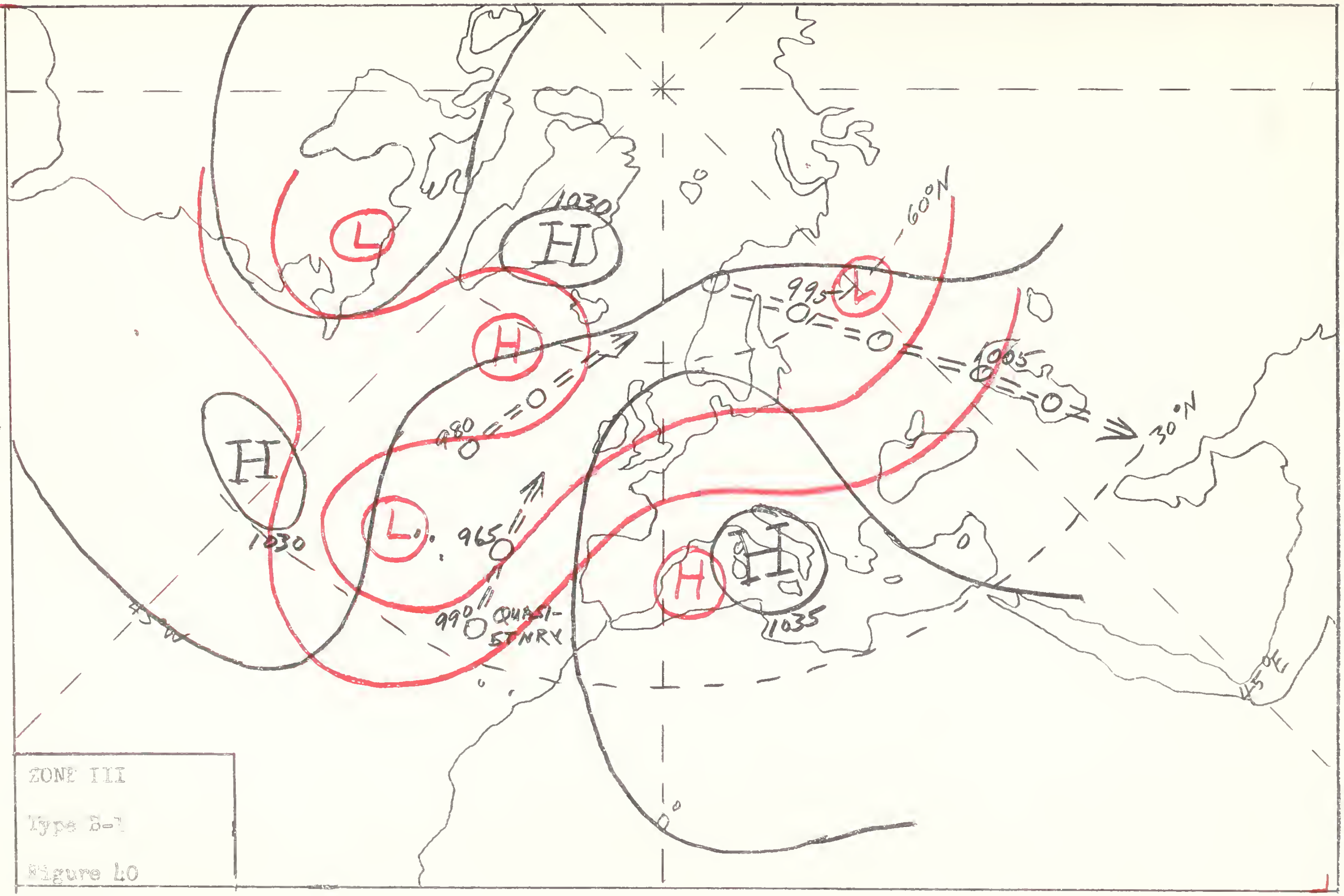
ZONE III

Type R-6

Figure 39

ZONE III Type B-1

This blocking type is somewhat rare and shows a most unique 500-mb pattern, A blocking High is situated in mid-North Atlantic with a trapped or cut-off Low to the south over the Azores. The flow around these two centers is sort of "reverse S". A moderate 500-mb ridge sits over Western Europe, often with a closed High to the south of France. On the surface, a strong ridge exists over the western Atlantic between the Bermuda High and a dynamic Greenland cell. A cPk air mass blankets Europe and the Mediterranean. In the ideal case for this type, a very deep Low develops in the vicinity of the Azores and remains quasistationary for several days (about 6), building in intensity. This Low is then steered slowly northward and gradually attains normal speed by the time it reaches the British Isles. At this point the Low is beginning to fill and recurves to the southeast. By the time the storm moves into Russia it is weak and moving almost due south. The life history of this type is normally about 8 or 9 days.



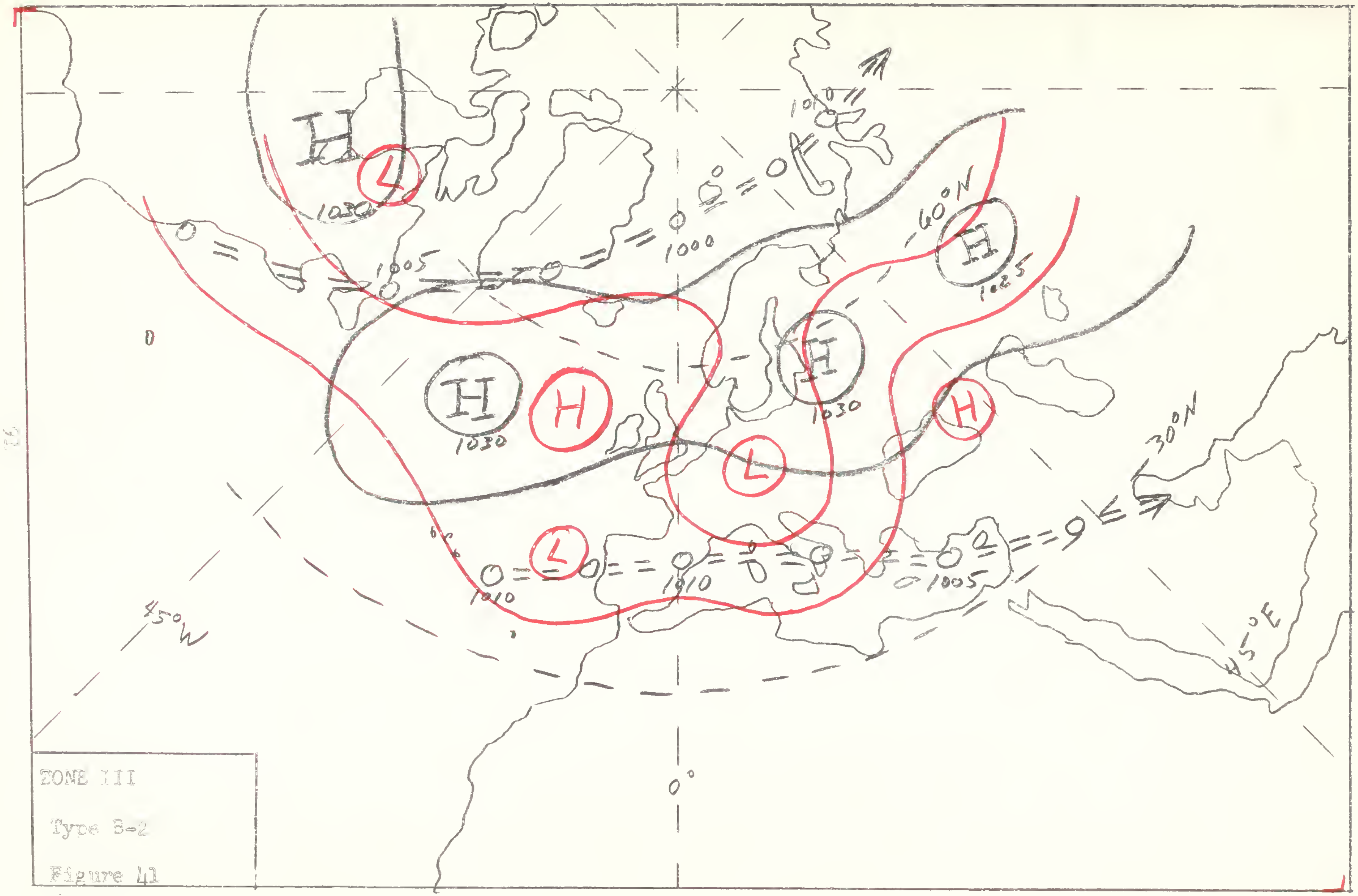
ZONE III

Type B-1

Figure 40

ZONE III Type B-2

This blocking type has a 500-mb pattern that shows a marked change in the latter half of the life history. Two strong ridges are initially present, the western one exhibiting a closed High just west of the British Isles, and the eastern ridge located on the eastern limit of the zone. As the type progresses, these two ridges lean towards the middle and gradually merge, forming one long, closed High north of a trapped, quasistationary Low that is present over Central Europe. This 500-mb closed High is flat and elongated E-W. On the surface, a well developed belt of high pressure extends from mid-North Atlantic into Northern Siberia. Two storm tracks usually occur with this type. The far northern track shows very rapid movment of the cyclones in the northeasterly direction across the Atlantic and into the Arctic Ocean, while the storms on the southern track are steered rapidly across Spain and then eastward through the Mediterranean. Both storm tracks normally exhibit rapid movement of rather intense cyclones. Type B-2 is very common in the winter and early spring and is quite persistent. In the latter stages, this type resembles Baur's Type IV.



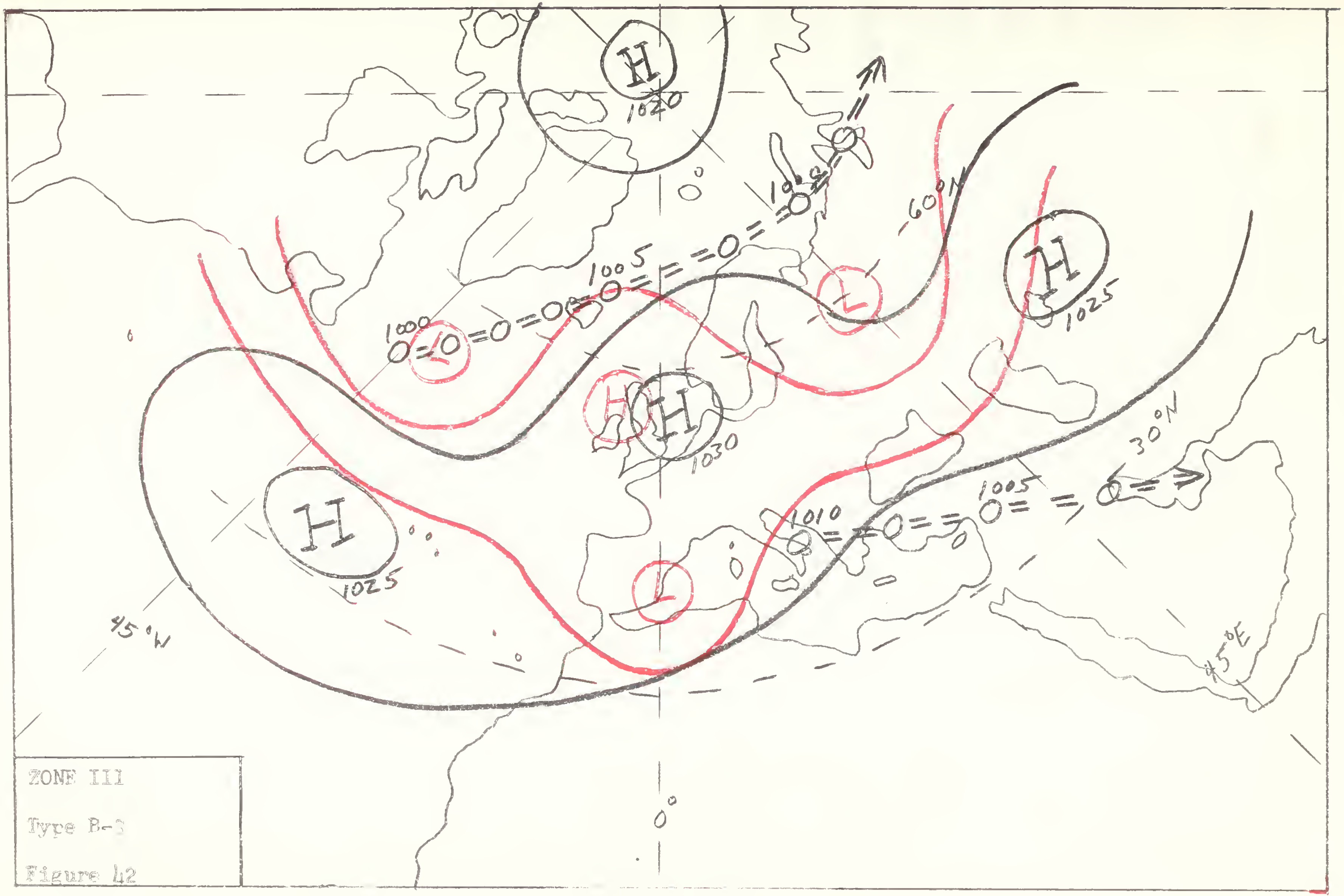
ZONE III

Type B-2

Figure 41

ZONE III Type B-3

This blocking type is perhaps the most common of all the "B" types in the zone, and is certainly the most persistent. The 500-mb flow shows a strong block in the center of the zone with a closed High centered over, or just west of, the British Isles, and a trapped Low to the south over the Western Mediterranean. On the surface the dominant feature is an intense dynamic High centered over England-Southern Scandinavia, with extensions both east and southwest to the Russian and Azores Highs respectively. Cyclones entering the zone from the west are steered northeastward very slowly until they break through the weak ridge joining the Greenland High with the dynamic High over England, and then the storms are rapidly steered eastward out of the zone. To the south, cyclogenesis occurs in the Mediterranean just east of Italy with the storms following an eastsoutheasterly track out of the zone. Generally, the intense High over England is of cPk origin, but in the spring or fall it is sometimes an off-shoot of the Azores cell. If the center of the dynamic High is located over England, this type can be forecast to persist for 8 or 9 days. Type B-3 corresponds quite closely to Baur's Type IV.



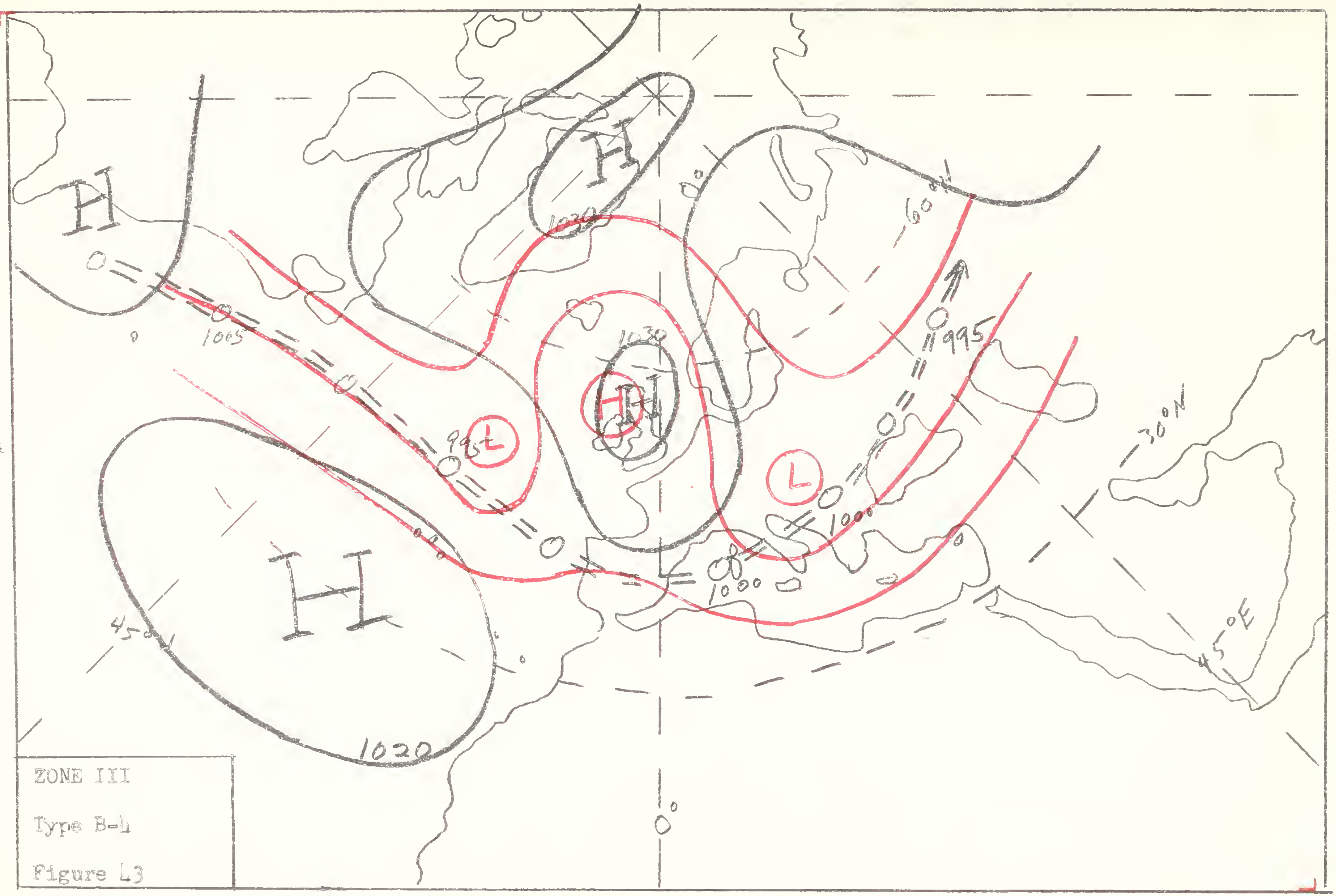
ZONE III

Type B-3

Figure 42

ZONE III Type B-4

This blocking type is characterized at the 500-mb level by a classical "omega" block. This block is situated in the middle of the zone with the associated closed High centered over the British Isles. On the surface, an intense Greenland High extends southeast to cover the British Isles, usually having a closed center in the extension. Cyclones leaving the Florida coast are steered rapidly eastward across the Atlantic and then either dissipate near the coast or take a very southerly track through the Mediterranean and into Russia. Their systems usually deepen and occlude in the vicinity of the Azores, and the 24 hour movement is somewhat greater than normal. This type is very persistent and is usually a wintertime situation. The 500-mb pattern is this type closely resembles that of Baur's Type VII.



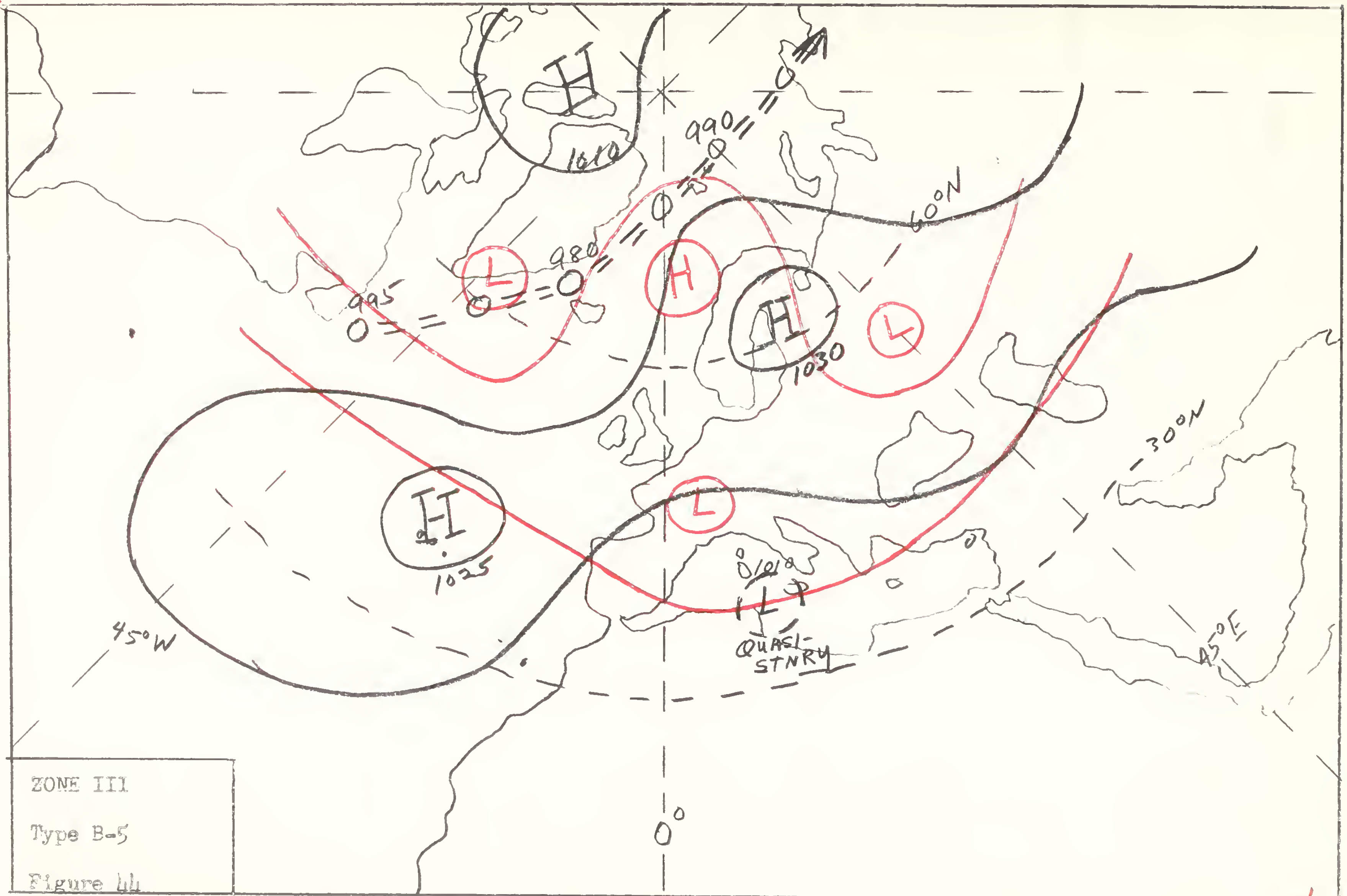
ZONE III

Type B-4

Figure 43

ZONE III   Type B-5

This type shows a 500-mb block with the closed High far to the north over Northern Scandinavia. A quasistationary trapped Low is centered over France with another upper-air Low over Southern Greenland. On the surface, an intense cAk air mass blankets all of Scandinavia and Russia with high pressure and has a ridge extending southwest over the British Isles to the Azores cell. Cyclones leaving the Newfoundland coast take a far northerly track to Iceland where intensification of the Lows occur. These storms become very intense and are then steered slowly northeast across Spitzbergen into the Arctic Ocean. A quasistationary Low center is usually present in the central Mediterranean. Type B-5 usually occurs in mid-winter and lasts from 6 to 8 days.



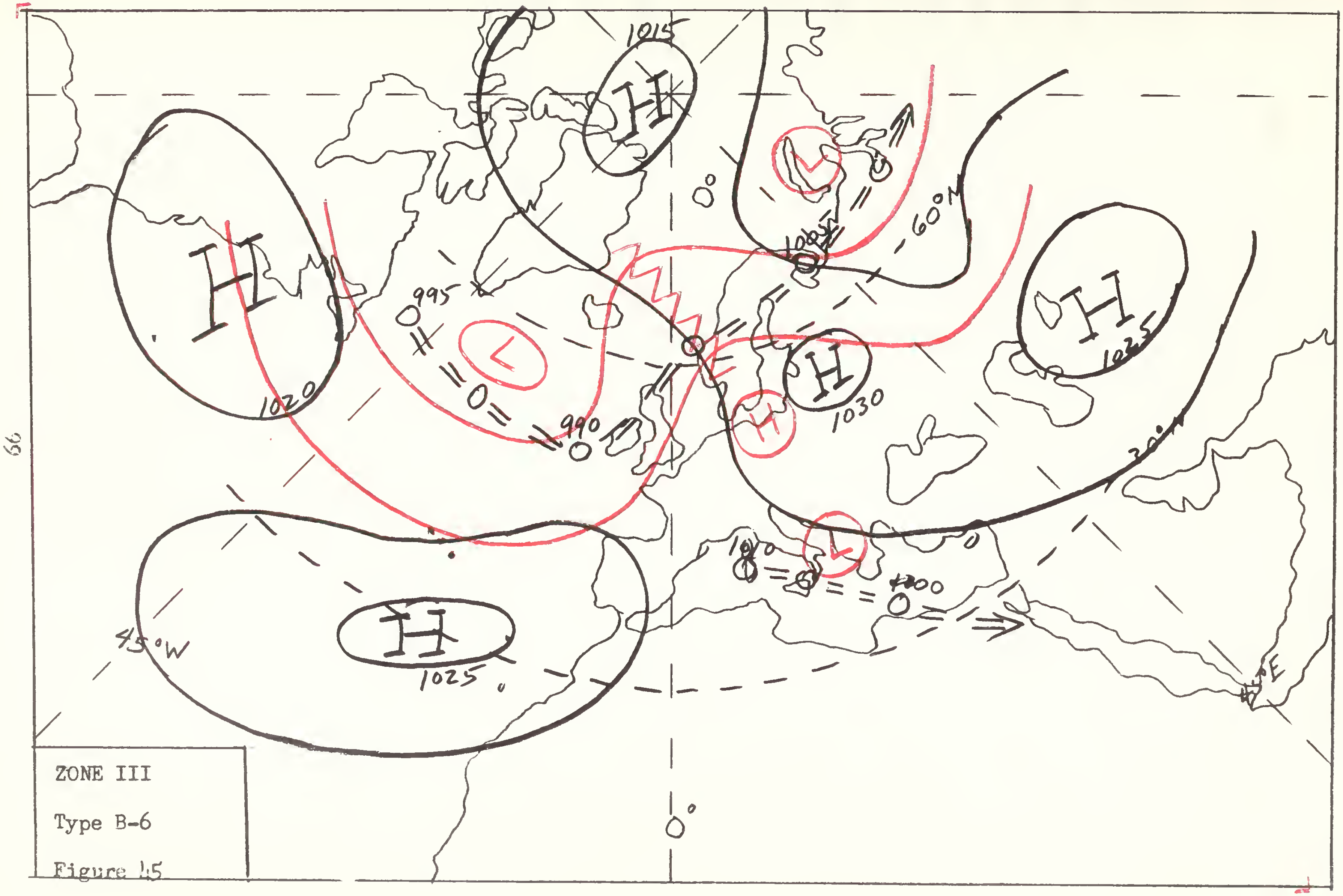
ZONE III

Type B-5

Figure 44

ZONE III   Type B-6

The main feature of this blocking type is a 500-mb ridge in the central part of the zone that has a south-southeast-northnorthwest tilt to its major axis. The closed High associated with this ridge is generally centered over North Central Europe and the system has a quasistationary trapped Low to the south in the Mediterranean. A deep upper-air Low with a very broad trough controls the North Atlantic. On the surface, the Greenland High has joined with the Russian cell to produce ridge conditions over most of Europe, with a dynamic High centered north of the Black Sea. Cyclones leaving the Labrador coast move slowly eastward across the North Atlantic until they reach Ireland. At this point intensification occurs and their centers are steered northeastward over the strong Arctic High and into Northern Siberia. In the Mediterranean, cyclogenesis is quite frequent and usually occurs to the west of Italy. These waves move rapidly southeastward out of the zone. This blocking type is quite persistent and occurs the year around, although favoring the spring and winter months.



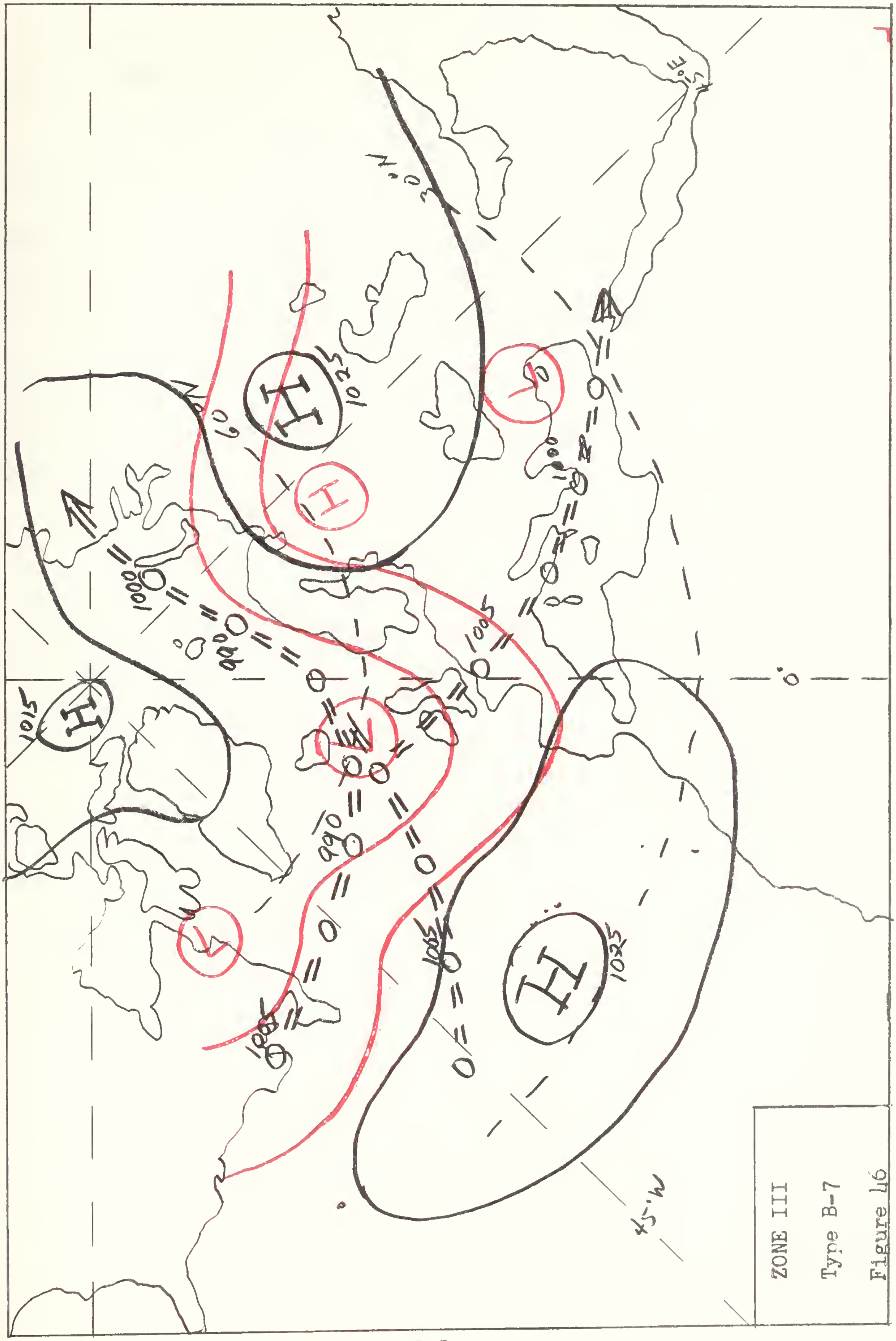
ZONE III

Type B-6

Figure 15

ZONE III Type B-7

This blocking situation is quite common within the zone as all of the major High centers are in their so-called "normal" positions. At the 500-mb level, a strong block exists on the eastern boundary of the zone with its associated closed High far north at about 55°N. A deep quasi-stationary upper-air Low is present just north of the British Isles and a trapped Low can usually be found over the Eastern Mediterranean to the south of the closed High. The surface picture shows the warm Azores cell, the thermal Greenland High, and the dynamic Russian High all in their "normal" positions. Lows entering the zone from the west provide intense cyclonic activity across the North Atlantic. These storms congregate near Iceland, where they deepen, and are then steered either to the northeast into the Arctic Ocean or southeast into the Mediterranean. The Jet on the eastern side of the 500-mb trough steers these storms around the eastern half of Europe, but also gives intense cyclonic activity to the north and/or south around the High. This is the most common blocking type within the zone and usually persists for 6 or 7 days.



ZONE III

Type B-7

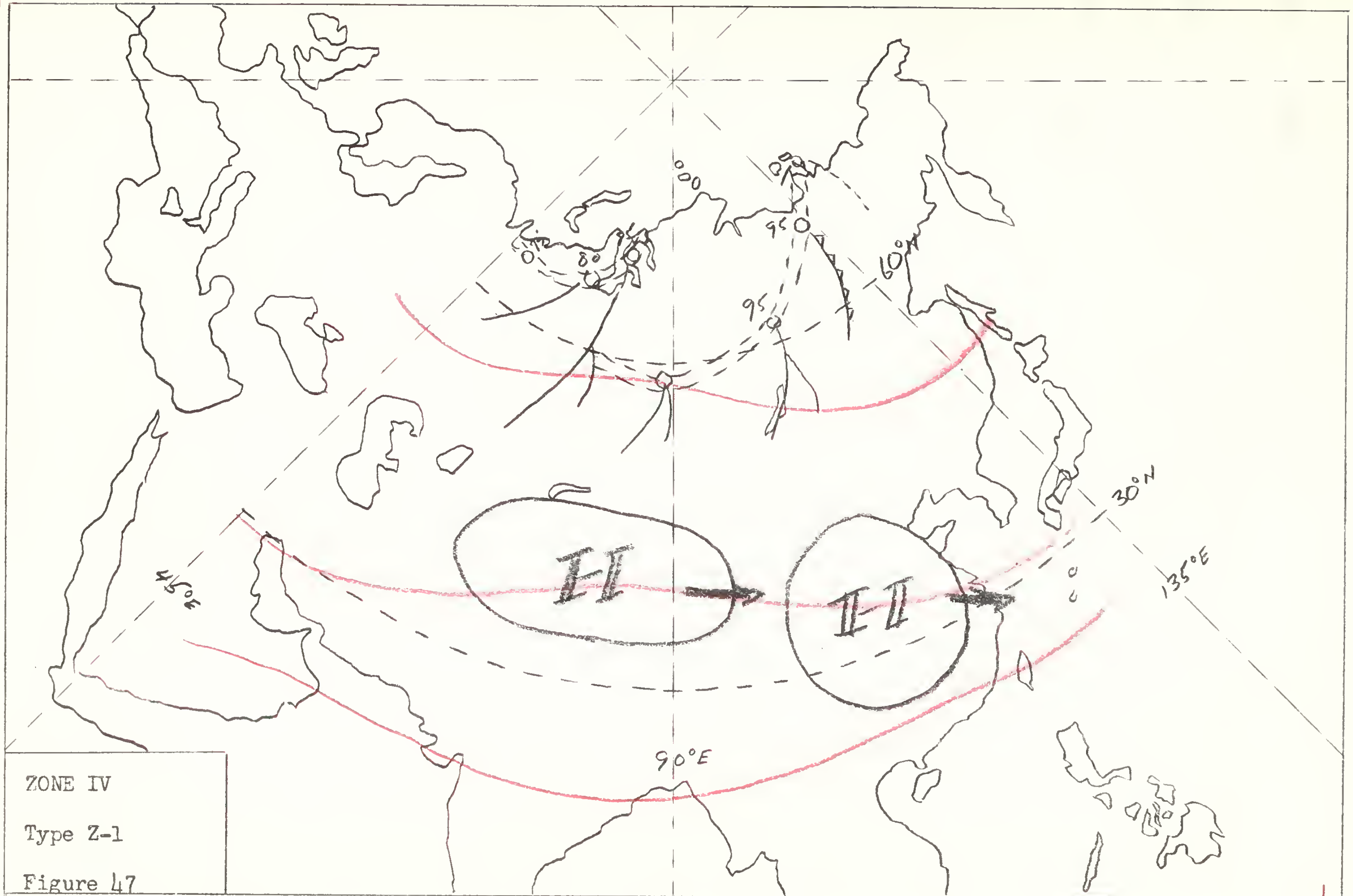
Figure 46

ZONE IV Type Z-1

The 500-mb pattern is one of broad zonal flow across Asia. During the winter months there is a weak contour gradient over the Himalayas associated with flow north and south of these mountains.

On the surface migratory thermal high-pressure cells move across Asia at about 35°N latitude. Deep, intense low centers associated with occluding systems arc up into the Kara Sea area from Zone III. These centers weaken and fill as they travel poleward. Occasionally Skagerraking occurs in this area but the new low-pressure centers do not become very deep as they swing up into the East Siberian Sea. The frontal system becomes a cold front aloft before disappearing entirely near the North Asian Coast.

This type can be quite persistent frequently lasting more than six days while at other times it is a transitory type lasting only two to three days.



ZONE IV

Type Z-1

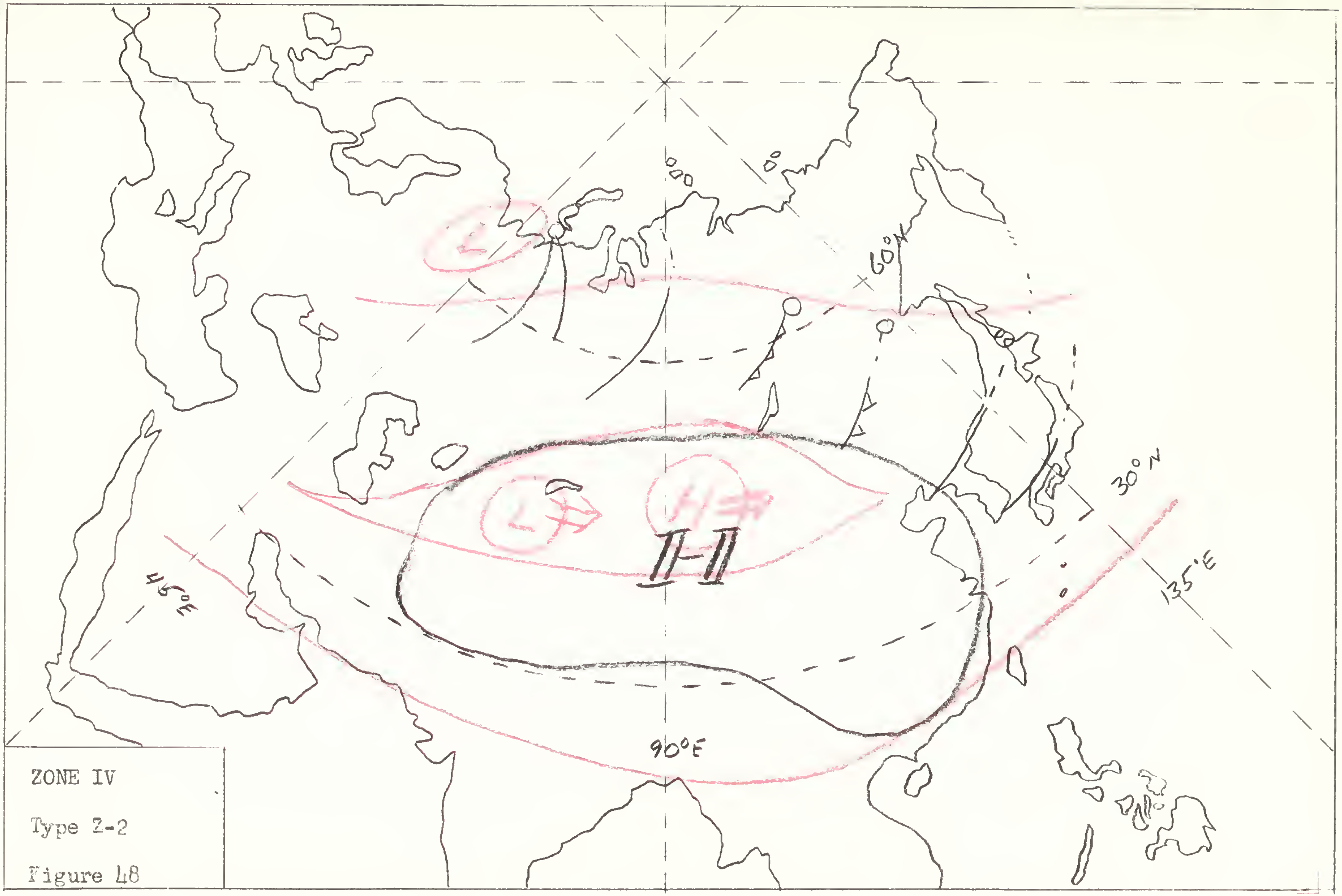
Figure 47

ZONE IV Type Z-2

This type is pictured in Figure 48 in its initial stage when evolving from a western blocking type. Frequently when a blocking type in the western part of the zone breaks down the high and/or low cell associated with the system migrates to the eastward and weakens. The broad zonal current is split for the first two or three days of the type then the closed centers disappear and leave a weak contour gradient over Central Asia. If this type evolves from a zonal type or Type R-2 there is broad zonal flow with a weak contour gradient over Central Asia for the entire life of the type. During the winter months there is also a weak contour gradient over the Himalayas associated with flow north and south of these mountains.

On the surface most of Asia south of 45°N latitude is covered by a thermal high cell. Weak low-pressure centers move southeastward from the Kara Sea region. Frontal systems associated with these low centers move aloft over Siberia. The southern segment of these fronts usually show up on the surface in the Sea of Japan area. Occasionally weak frontal systems will move eastward south of the Caspian Sea region in the Winter.

This type follows another zonal type, a Zone IV western blocking type, or a Type R-2. The type is usually fairly persistent lasting five to six days.



ZONE IV

Type Z-2

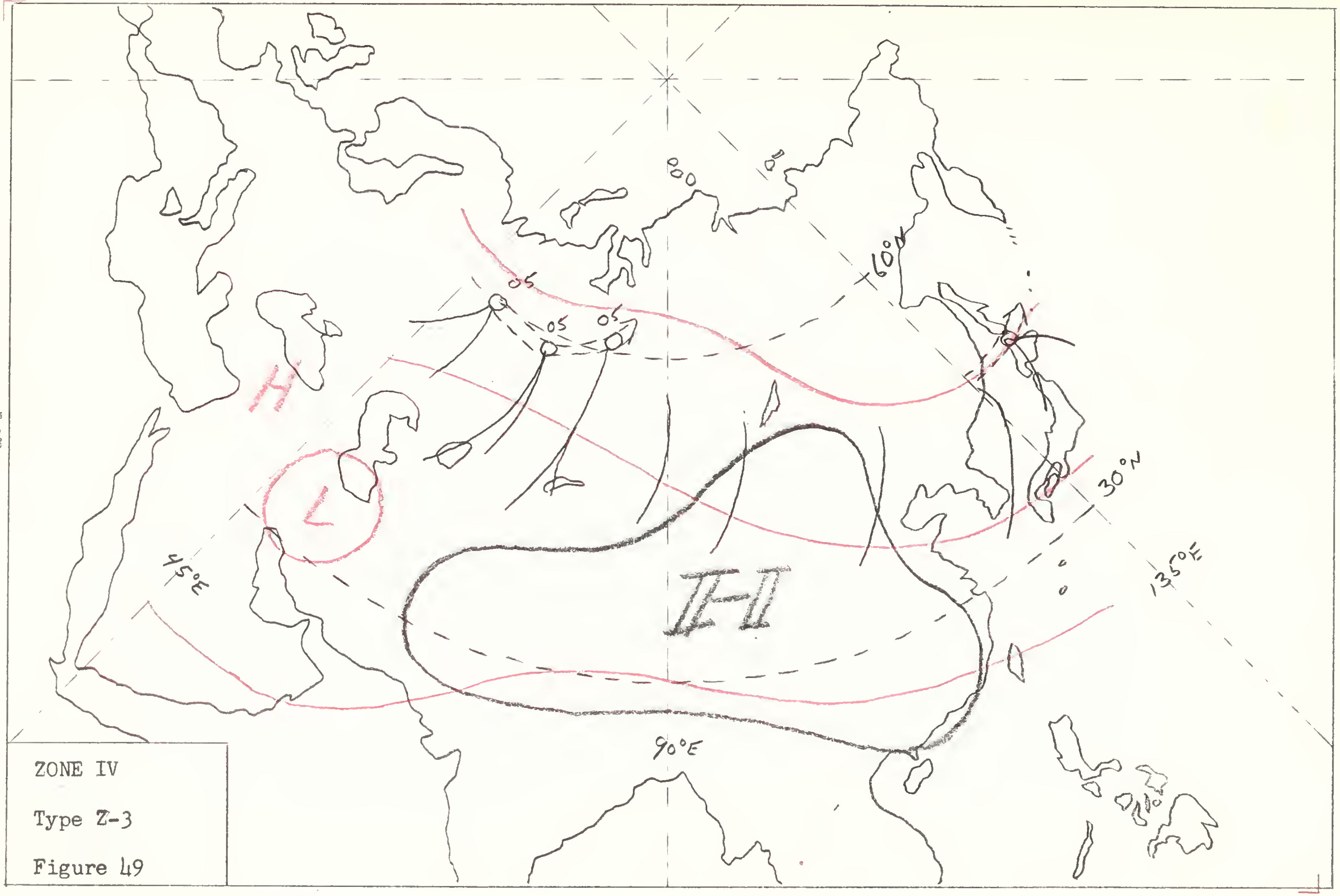
Figure 48

ZONE IV   Type Z-3

The broad zonal current associated with this type funnels into a trough over the Asian Coast. A stationary cold low is sometimes located south of the Caspian Sea.

On the surface most of Asia south of 45°N is covered by a thermal high cell. Weak low centers enter the zone from the west near 60°N latitude and swing north. Cold frontal systems associated with these lows move eastward across Asia under the upper-air flow. These fronts usually form new waves off Japan.

This is a very common type in Zone IV but generally does not persist longer than three or four days.



ZONE IV

Type Z-3

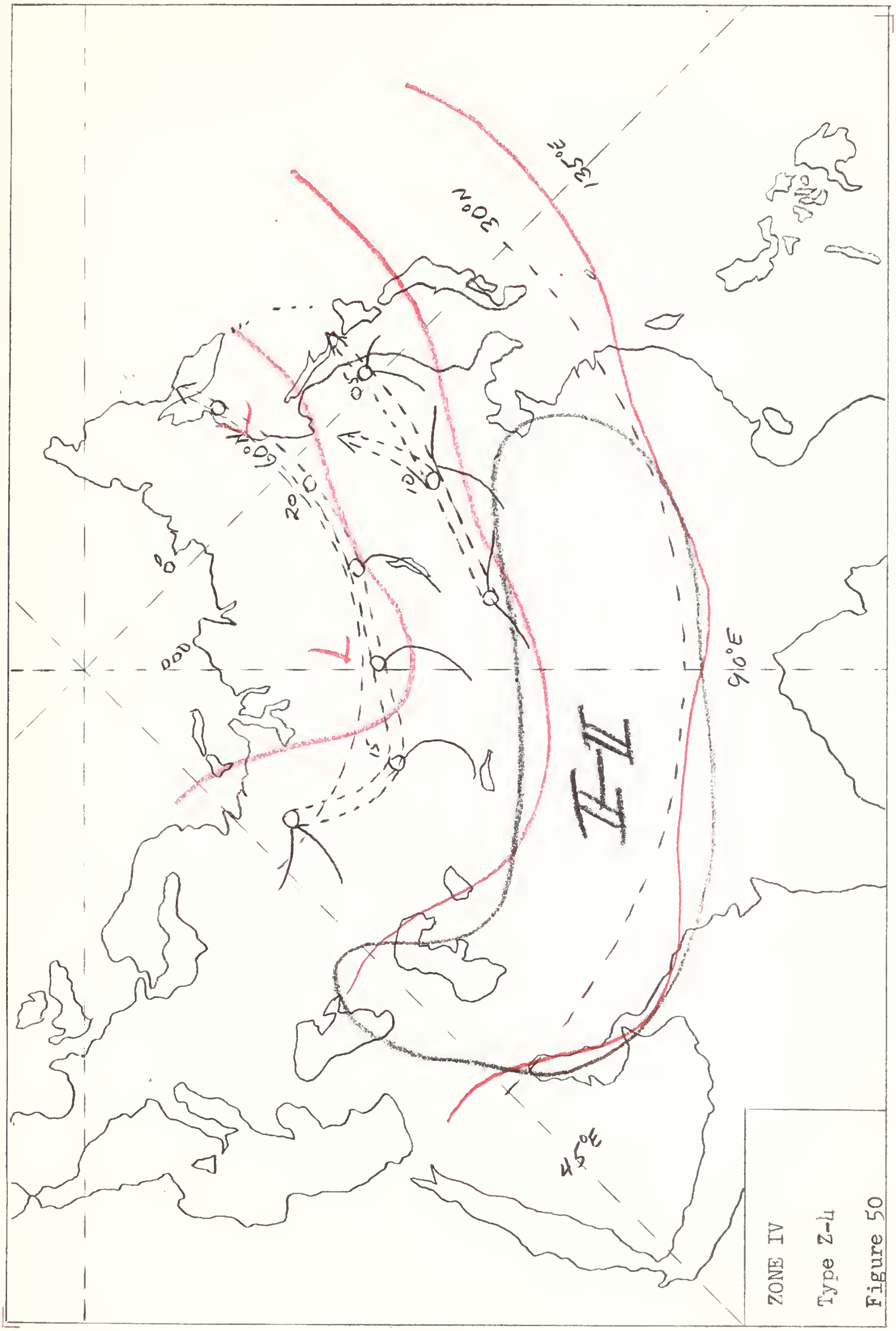
Figure 49

ZONE IV Type Z-4

This type is usually associated with a blocking system or ridge in Zone III near 35°E longitude. A trough oriented northeast-southwest is present over Central Asia. Broad zonal flow is present over Asia at 500 mb.

On the surface the area south of 45°N latitude is usually covered by thermal high cells. Low-pressure centers move across Asia at about 15° longitude per day near 60°N latitude. Frequently wave cyclones form ahead of the upper-air trough in Central Asia and move eastward of up into the Okhotsk Sea region.

This is a frequent type in Zone IV and usually follows another zonal type.



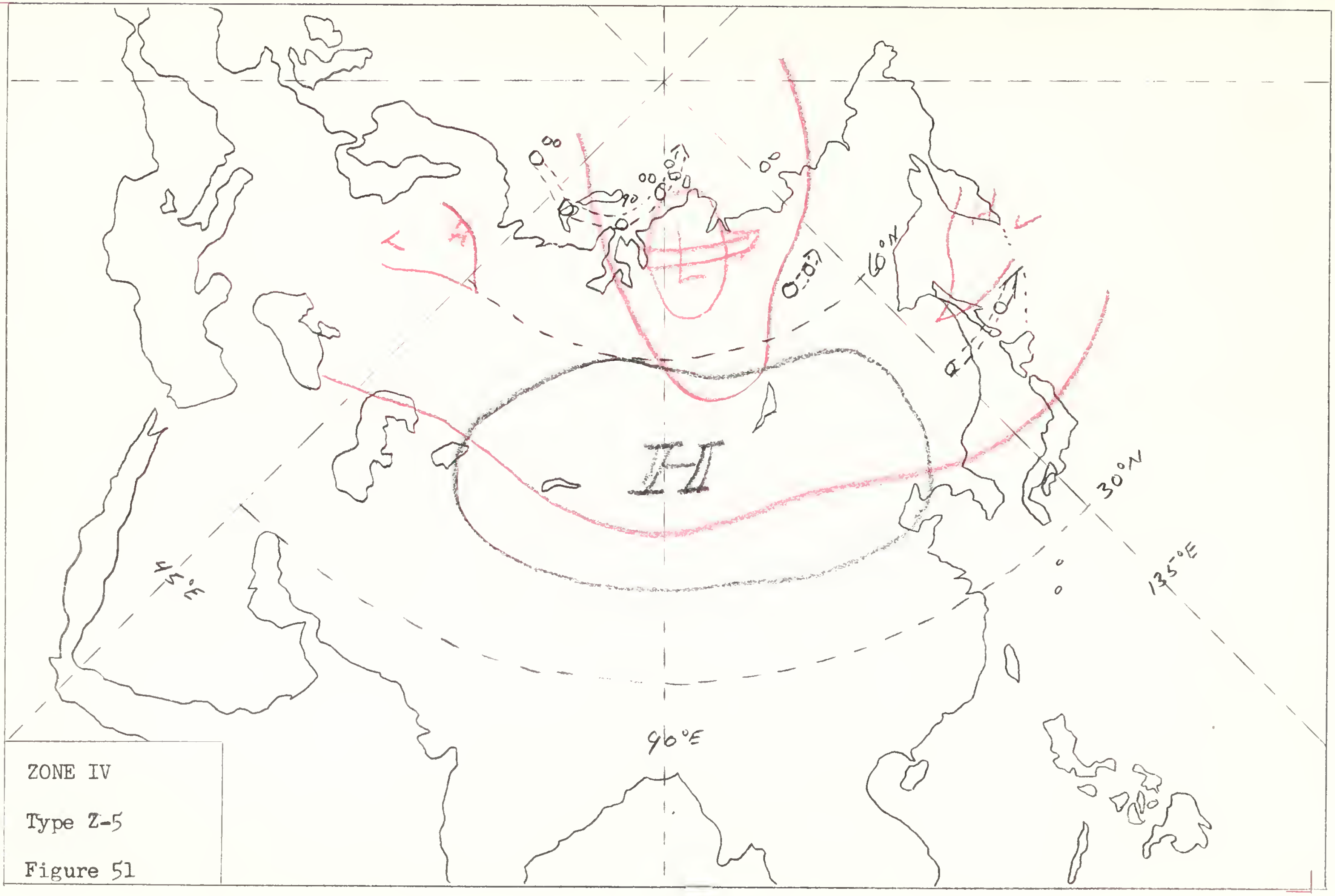
ZONE IV
Type Z-4
Figure 50

ZONE IV Type Z-5

The Main current at 500 mb flows zonally across Asia between 45°N and 60°N latitude. A cold low-pressure center moves relatively rapidly eastward near the Arctic Circle. The unique feature of this type is the blocking systems that usually exist simultaneously in Zones I and III during the time Z-5 is present in Zone IV.

On the surface most of Asia south of 60°N is covered by the Siberian high cell. Low-pressure centers move from north of Scandanavia up through the Kara Sea toward the Pole. Cyclogenesis occasionally occurs north of the Sea of Japan.

This type does not occur too frequently. It is a Spring type generally requiring a western blocking system in Zone I and an eastern blocking system in Zone III.



ZONE IV

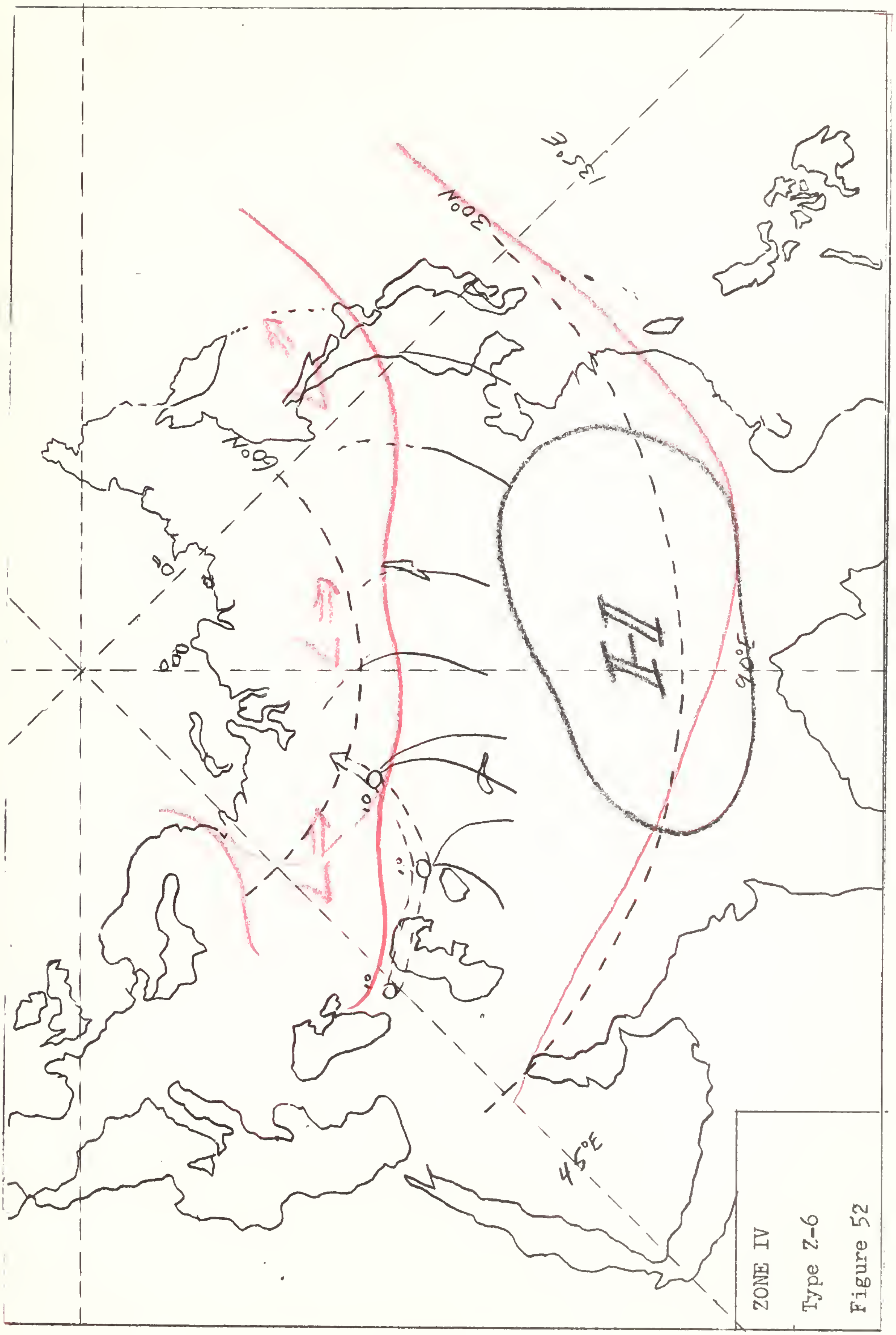
Type Z-5

Figure 51

ZONE IV Type Z-6

This type is usually associated with a blocking system or ridge off the European Coast. The 500-mb main current is a broad zonal band flowing south of 60°N latitude. A cold low-pressure center occasionally exists north of the Black Sea-Caspian Sea region.

On the surface low-pressure centers move from the Black Sea area in an arc northward. These low centers usually have a weak pressure gradient and are not very deep. Fronts associated with these low centers move eastward across Asia. The northern segment of these fronts usually undergoes frontolysis while the southern segment moves off the Asian Coast and develops new waves off Japan. Stationary fronts of a latitudinal nature are common along the northern periphery of the thermal high in Southern Asia.



ZONE IV

Type Z-6

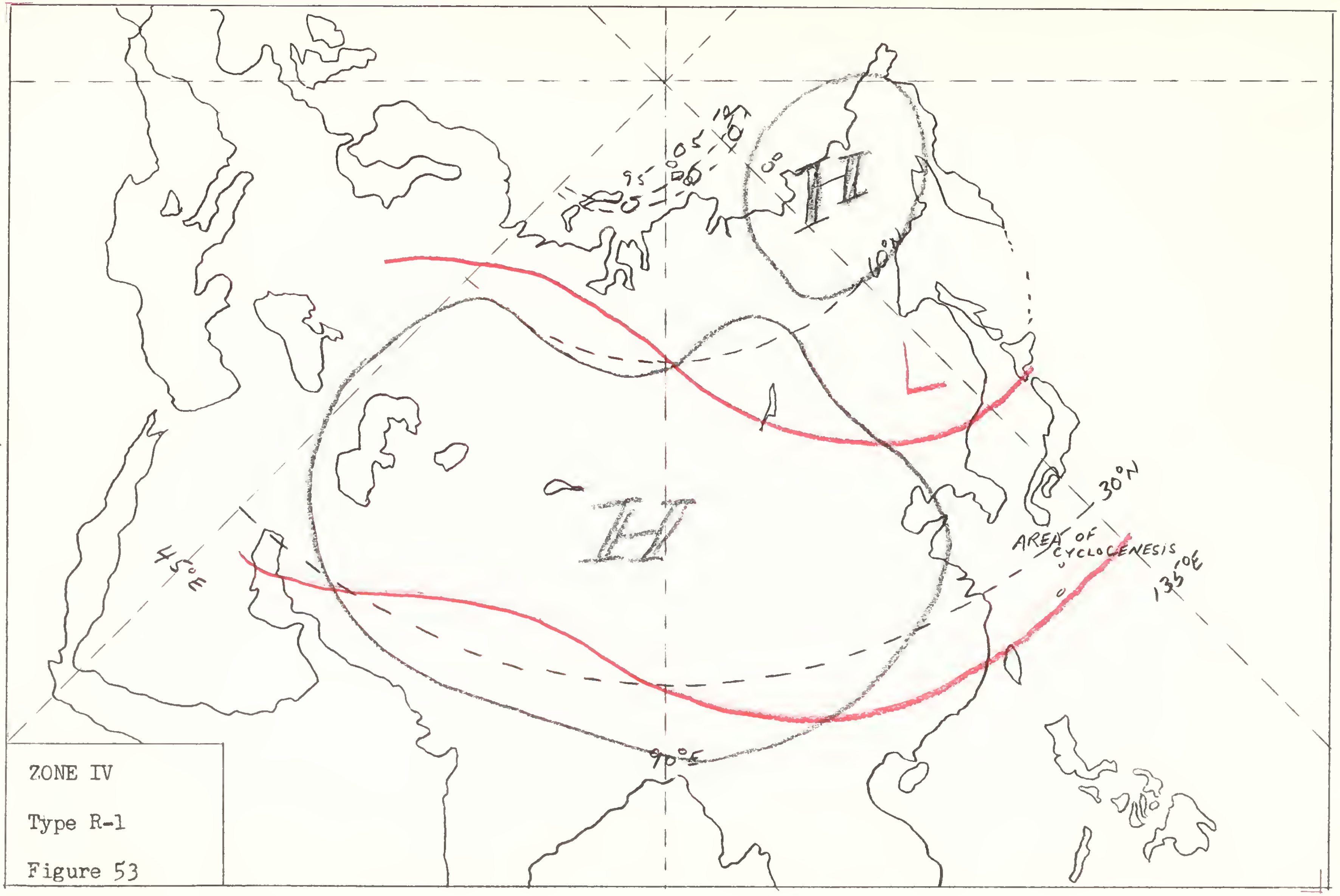
Figure 52

ZONE IV Type R-1

This type has a broad main current at the 500-mb level. There is a ridge at about 70°E longitude that does not build too far northward. A trough is located over the Asian Coast.

On the surface almost all of Asia is covered by the Siberia high cell. Low-pressure centers move along the Northern Coast of Asia recurving poleward and filling. Cyclogenesis occurs in the area south of Japan.

This is an infrequent type usually occuring in the late Fall.



ZONE IV

Type R-1

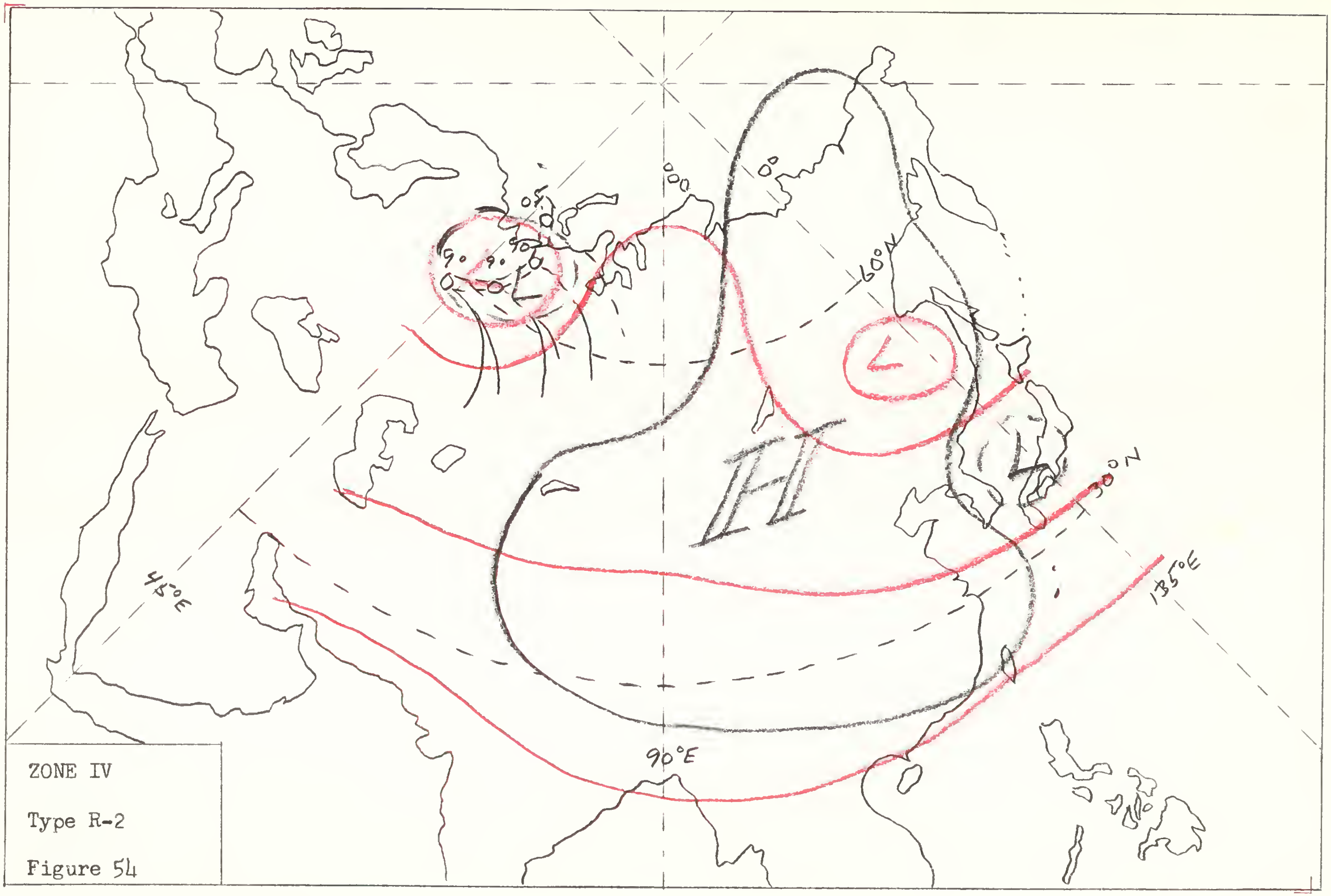
Figure 53

ZONE IV   Type R-2

This type is identified at 500 mb by a ridge that builds rapidly northward near 90°E longitude. Sometimes a closed dynamic high develops in this ridge. Cold low-pressure centers exist on either side of the ridge. The 500-mb flow becomes more meridional with this type than any other ridge type in Zone IV.

On the surface the Siberian high-pressure cell covers most of Asia east of the Ural Mountains. Low-pressure centers associated with occluding systems in Zone III swing northward and fill when they reach the White Sea region. Cyclogenesis off the Asian Coast in the Yellow Sea region is very common with this type.

This type is sometimes very persistent especially when the closed dynamic high is present in the 500-mb ridge. The type lasts at least five days and usually longer when the high cell is present at 500 mb.



ZONE IV

Type R-2

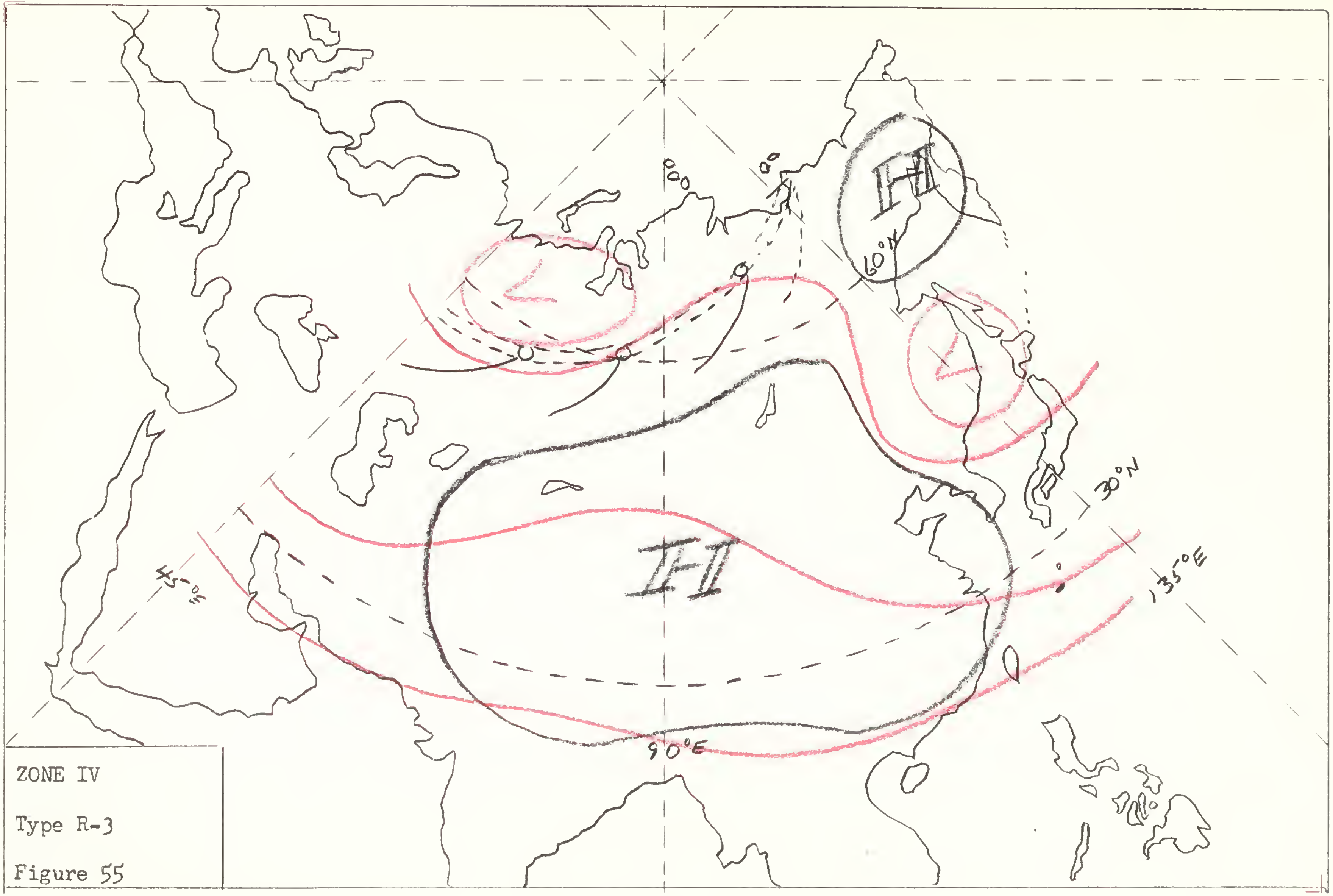
Figure 54

ZONE IV   Type R-3

This type is identified at 500 mb by a ridge that is located over Siberia oriented northeast-southwest. This ridge does not generally build too far to the northward. Two closed cold low centers are located on either side of the ridge, one south of the Kara Sea region and the other north of Japan.

On the surface a thermal high-pressure cell covers most of Asia south of 60°N latitude. Low-pressure centers enter the zone from the west near 60°N latitude and swing northeastward toward the East Siberian Sea. Because the pressure values or these low pressure centers varied considerably in each appearance of this type no typical pressure values were assigned them.

This type is generally not very persistent. It usually lasts only three to four days.



ZONE IV

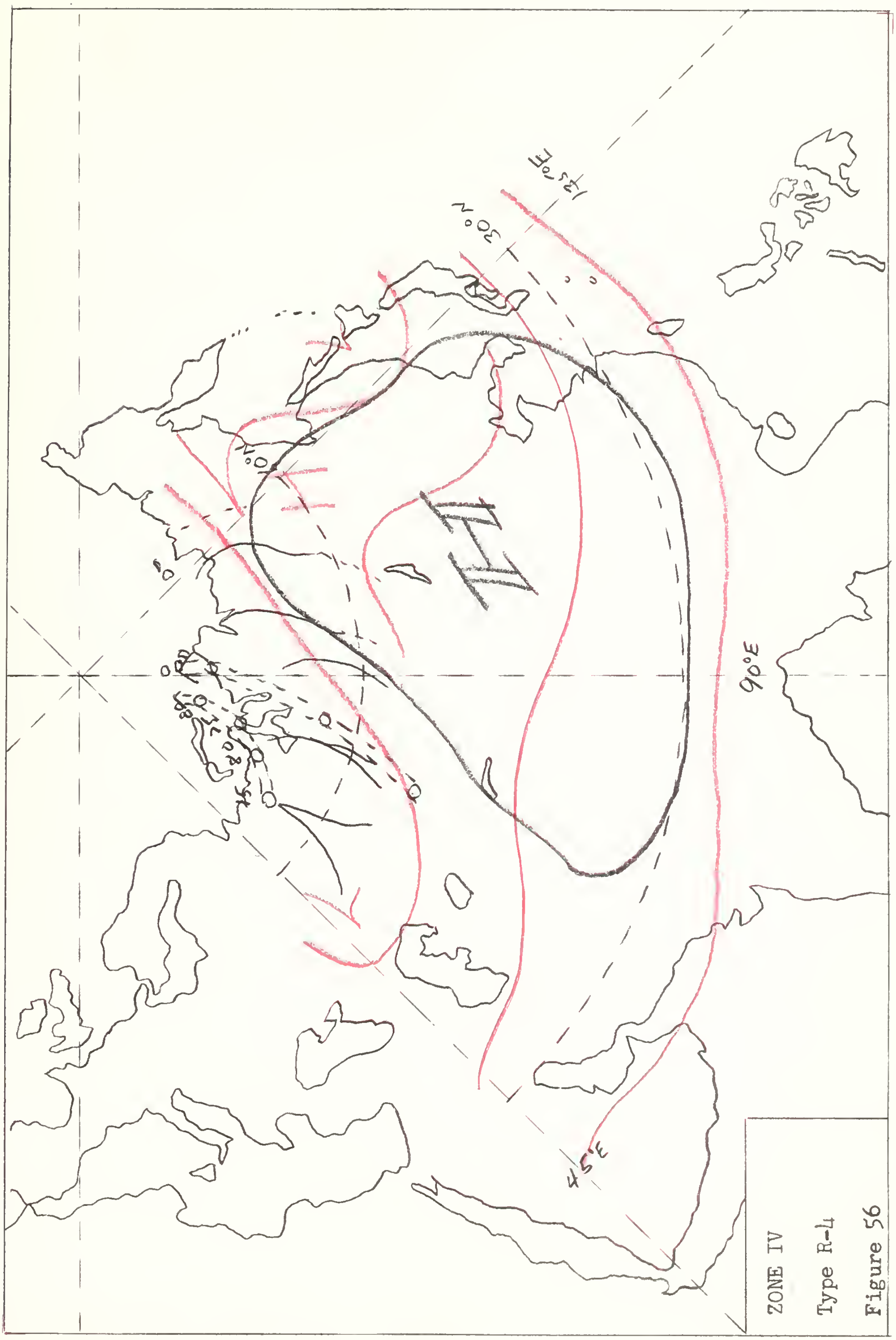
Type R-3

Figure 55

ZONE IV Type R-4

This type has a deep trough at 500 mb located between 45°E and 60°E longitude. There is a ridge oriented northeast-southwest over East Asia. Tight gradient contour flow in the trough fans out into a weaker gradient south of the ridge. The 500-mb main flow is usually split as it flows off the Asian Coast. One branch flows eastward from the top of the ridge while the other branch flows southward along the coast and over Japan. Generally the jet core is near the 500-mb level over Japan and is quite strong.

On the surface most of Asia east of the 500-mb trough is covered by the Siberian high-pressure cell. Low-pressure centers move northward ahead of the upper-air trough toward the Pole. Frontal systems associated with these lows occlude and move erratically eastward. Frontolysis occurs along the north coast of Asia in Northeast Siberia. During the Spring when the high cell is weaker, fronts sometimes can be traced across Asia under the upper-air flow to the Yellow Sea area. Cyclogenesis is very common off the coast of Japan with this type.



ZONE IV

Type R-4

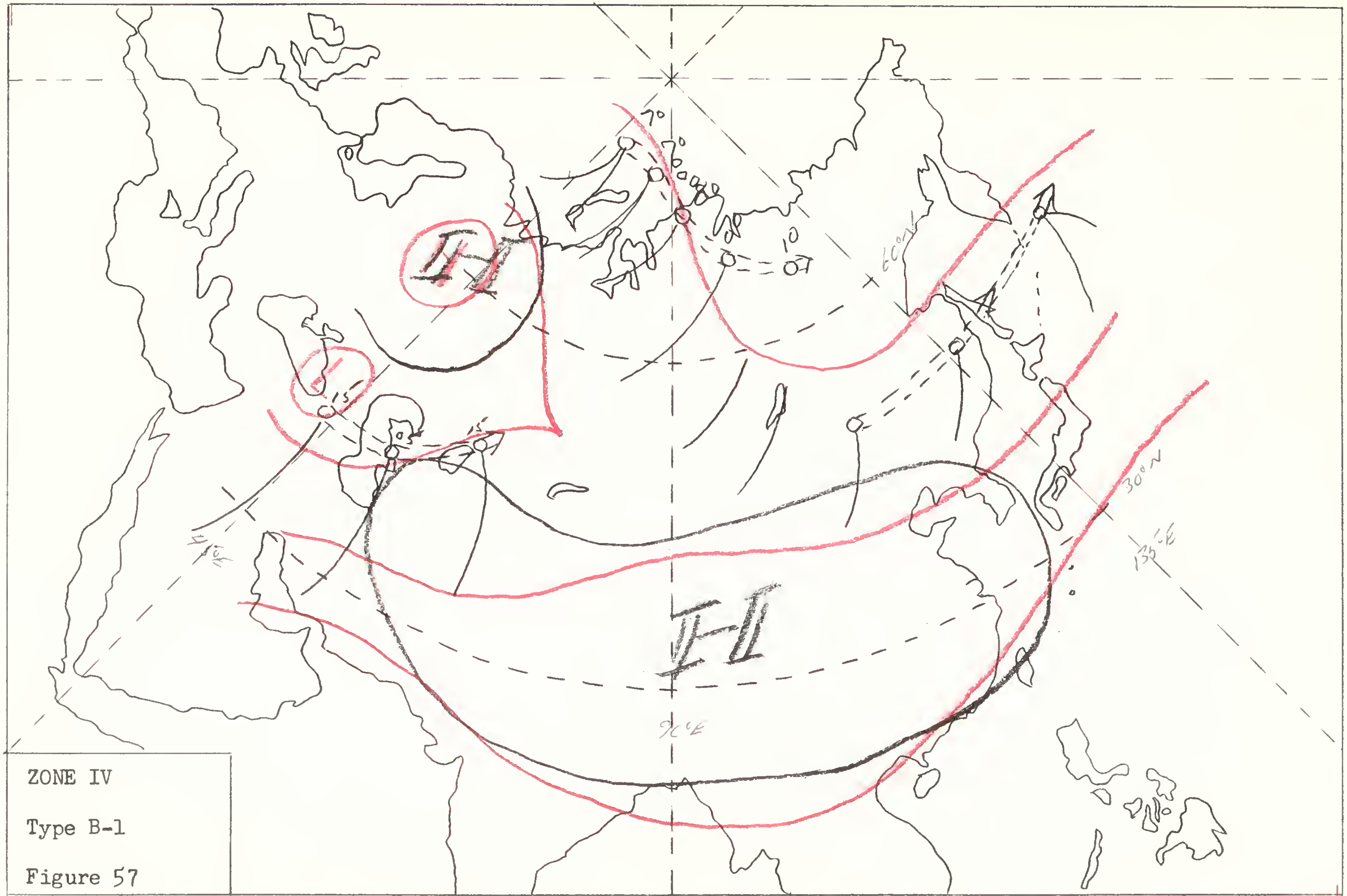
Figure 56

ZONE IV Type B-1

The blocking system that occurs with this type is located near 40°E longitude in Zone III. The 500-mb main current flowing into the zone is split, one branch coming from the Barents Sea region and the other flowing in from the Mediterranean Sea region. The two branches join to the east of the Ural Mountains and flow eastward over Japan. 500-mb winds over Japan are generally quite strong.

On the surface most of Asia south of 45°N is covered by a thermal high cell. Deep low-pressure centers move over the North Coast of Asia in the Kara Sea region and fill rapidly over the Continent. Occluding systems associated with these low centers often evolve into cold fronts that move across Asia under the upper-air flow. These fronts frequently form waves in the Yellow Sea region as they move off the Asian Continent. Occasionally weak low-pressure centers move eastward from the Black Sea region. These centers usually become indistinct in the Southern Ural Mountain region. In the early Fall and late Spring there is no main current flow south of the Himalayas and the thermal high cell is not as strong.

This type is usually very persistent.



ZONE IV

Type B-1

Figure 57

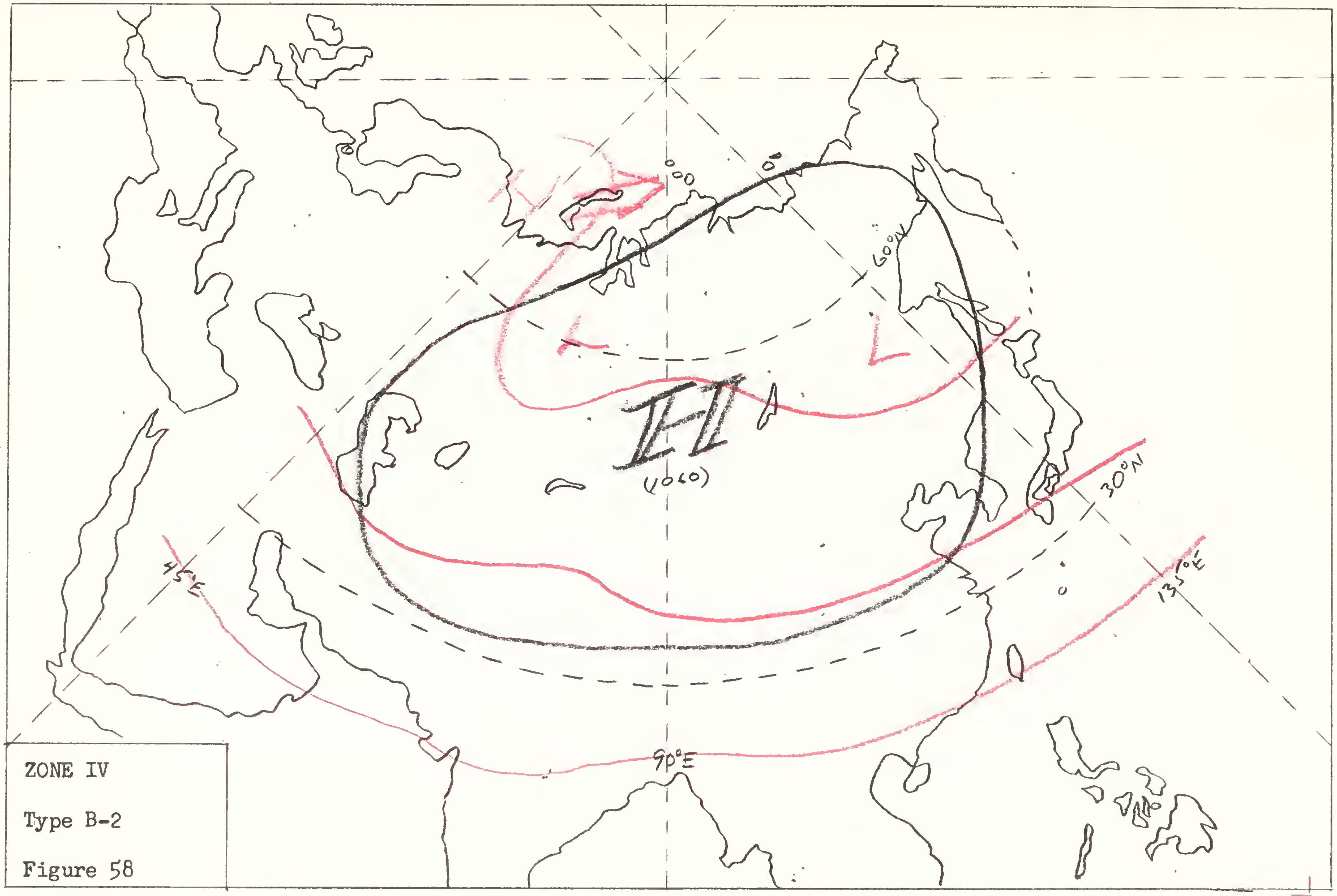
ZONE IV Type B-2

The blocking system that identifies this type is located between 40°E and 60°E longitude and usually north of the Black Sea-Caspian Sea region. The blocking high moves to the east or northeast slowly. Flow over the zone south of 50°N is generally quite zonal.

This is perhaps one type that can be recognized by the surface situation easier than by the 500-mb pattern. On the surface the Siberian high cell starts to build up in Central Asia. In 48 to 72 hours this thermal high cell covers the entire Asian Continent north of 30°N latitude. The central pressure of this cell is usually near 1060-mb. Any frontal systems present in Asia move southward on the periphery of the high cell as it expands. These fronts become stationary south of 30°N latitude and soon undergo frontolysis.

Although this type is predominently a winter type it does occasionally occur in the Spring and Fall. During these seasons the thermal high is not quite as strong. Weak frontal systems sometimes move eastward across Asia near 60°N latitude. There is no main current flow south of the Himalayas.

This is a persistent type especially in the winter months.



ZONE IV

Type B-2

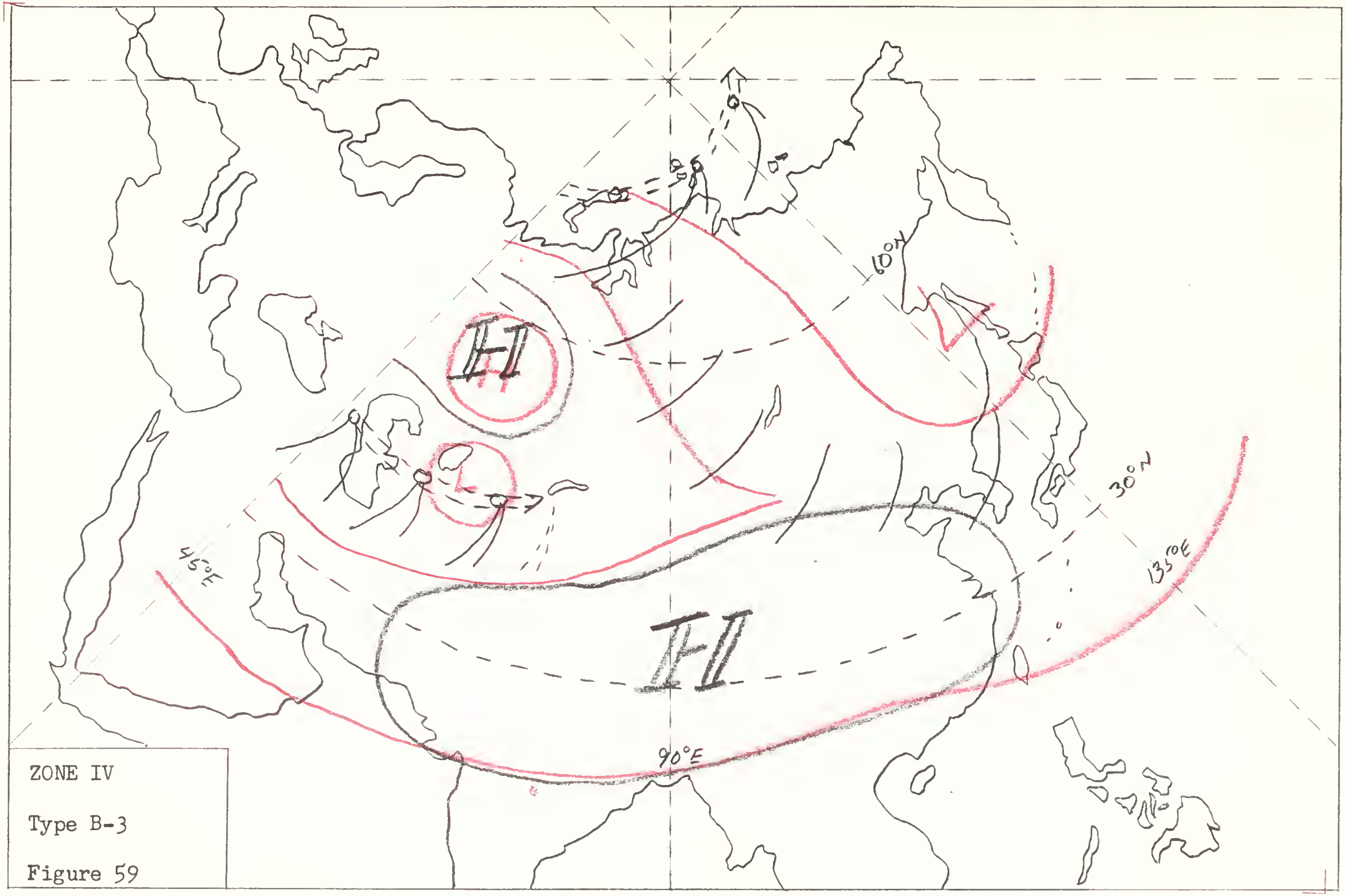
Figure 58

ZONE IV   Type B-3

A blocking system exists at 60°E longitude. The 500-mb main current entering the zone from the west is split, one branch flowing southeast from the Nova Zemlya - ara Sea region and the other branch flowing east at about 30°N latitude. Both branches join east of the Himalayas.

On the surface most of Asia south of 45°N is covered by a thermal high cell. Low pressure centers swing around the Arctic in the northern part of this zone. Segments of cold fronts associated with these low centers occasionally move across Asia under the upper-air flow. These fronts usually develop waves in the Yellow Sea region. During the winter these fronts are not as common as they are in the Spring and Fall. Weak low pressure centers move over the Black Sea eastward usually losing their identity before reaching the Lake Balkhash region. Because the pressure values of the low pressure centers varied considerably in each appearance of this type no typical pressures have been assigned to them in Figure 59.

This is a persistent type seldom lasting less than five days and usually considerably longer.



ZONE IV

Type B-3

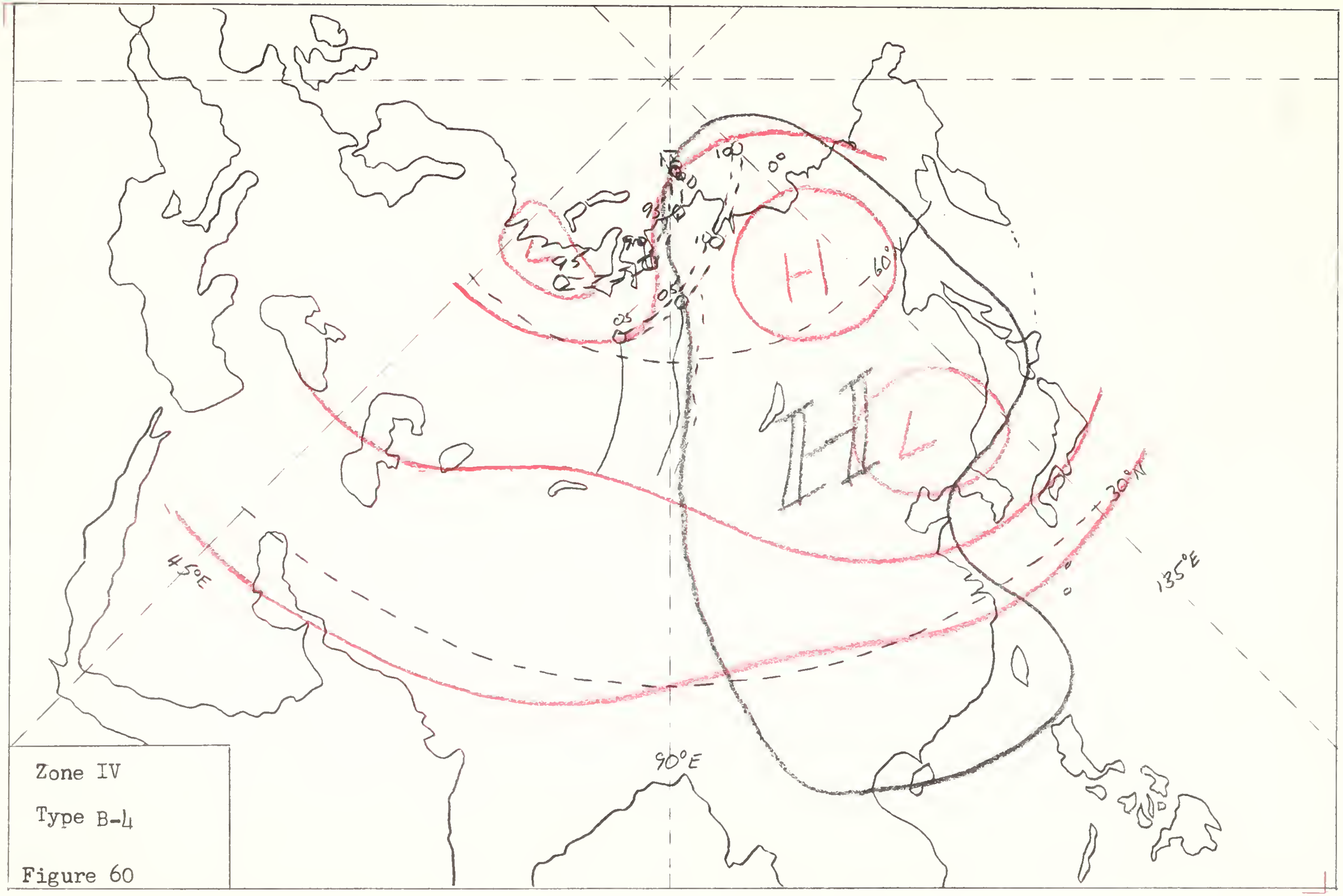
Figure 59

ZONE IV Type B-4

The blocking system that identifies this type is located over the Asian Coast at 500 mb. A closed cold low is usually present over the Kara Sea region. The 500-mb main current splits at about 90°E, one branch flowing north of the blocking system, the other flowing south. The southern branch is reinforced over the coast by flow that has gone south of the Himalayas. The jet stream at 500-mb is usually south of Japan and quite strong.

On the surface the Siberian high pressure cell covers most of Asia east of 90°E longitude. Low pressure centers move along the North Asian Coast recurving toward the Pole west of the high cell. Fronts associated with these low centers move slowly and erratically. They undergo frontolysis on the west side of the high cell.

This type is the most infrequent of the blocking types but is usually quite persistent when it does occur.



Zone IV

Type B-4

Figure 60

CONCLUSIONS

The principal aim of this paper was to extend the present weather typing techniques of extended-range forecasting so that the principle of weather typing could be used on a hemispheric basis. However, it was soon realized that, due to time limitations, only a small start could be made in this direction, even though all of the previous work done in the field was utilized to the fullest extent.

The use of the weather-type method for extended-range forecasting has long been known to depend upon two basic factors:

1) accuracy in typing the present map;
2) ability to forecast the persistence of the present type or the advent of a new type.

The first consideration dictates the degree of objectivity of the method. It is felt that utilization of the 500-mb flow pattern to identify the Hemispheric Types decreases the subjectivity involved, but does not make this an entirely objective method. Indeed, for any forecaster to use the Hemispheric Weather Typing method, or any other weather typing method, he must first go back through a historical series (or file) of weather maps so that he may become familiar with the various types. He must look ahead, behind, and investigate the type from every aspect. It will then be realized that, while the composite maps illustrating the Hemispheric Weather Types offer a handy catalog of the most salient features of each type, they by no means cover every possible weather

situation. Some of the Hemispheric Types, such as the blocking situations, are very well delineated, but there are other types that require considerably more judgment and skill on the part of the forecaster. The reader must bear in mind that all research was done with the aid of the Historical Weather Map Series, and therefore, the results have necessarily been limited by the scale and time interval of these maps.

Once the forecaster has become familiar with the various types, the second basic consideration must be met. This is by far the most difficult of the two and, as such, holds the key to the successful forecast. If this problem were solved, weather typing would become an extremely practical tool in extended-range forecasting.

This paper has established no concrete results as regards the above problem. At present it is felt that the best use of the Hemispheric Weather-Type models would be in conjunction with a numerical 500-mb prognosis. The Hemispheric Types would then offer an excellent first approximation for the surface prognosis.

A tabulation of the blocking types in each of the four zones, along with the types that appear in the zones to the east and to the west, has been listed in Appendix II. It should be noted that this is an irreversible table. i.e., if Type B-6 occurs in Zone III, there is a good chance that an R-4 will appear in Zone IV. However, if an R-4 appears in Zone IV, this is no guarantee that a B-6 will appear in Zone III. It is significant to note that no correlation was found between

opposite zones in the hemisphere. The only exception to the foregoing occurs when a blocking type is established in one maritime zone, and then a blocking type will normally appear in the other (opposite) maritime zone within one or two days.

Some significant observations are recorded herein to aid the forecaster:

1. A tabulation of the Hemispheric Types in each of the four zones reveals a basic similarity between the two maritime zones (I and III) and also between the two continental zones (II and IV). i.e., blocking types and ridge types are more numerous in the maritime zones.

2. Blocking types occur more frequently in the eastern ends of the maritime zones in the winter months and migrate to the west as spring approaches.

3. Generally, one to three blocking types will appear repeatedly during the course of one index cycle. This statement can often be extended to include the ridge types.

4. From Appendix III, it can be seen that the sequence of types usually runs from zonal to ridge to blocking and then back to zonal. However, if a particular zonal type persists for six days or more, then the succeeding type will generally be blocking.

5. If a blocking type exists in one maritime zone, then a blocking type will normally be present in the other maritime zone.

It is felt that the size of the sample of data (Appendix III) is not sufficient to justify statistical evaluations. If

such evaluations were performed, little reliability could be attached to them.

Other appealing avenues of investigation appear to be:

1. Investigation as to possible correlation between type changes and the eccentricity of the polar jet stream.
2. Investigation as to the correlation between isotach maxima of varying intensity and type changes.
3. Investigation of indications in the levels above 500-mb (250-mb, 100-mb, or level of maximum winds) as to the persistence or change of the Hemispheric Types.

Another task that must be accomplished prior to using the Hemispheric Types for other than large scale forecasting is the assignment of precipitation patterns, frontal locations, and various other weather parameters to each type.

In summary, hemispheric weather type patterns have been developed for each of four octants around the Northern Hemisphere, thus giving complete coverage over half of the Earth. These types could be used in conjunction with a 500-mb numerical prognosis to give a first estimate of the surface prognosis. The ability to forecast the persistence or advent of new types has not been attained. Avenues of research to gain this objective have been outlined.

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APPENDIX I

The following table lists the Hemispheric Types or Zone II as they correspond to Elliott's North American weather types.

Hemispheric Zone II	North American
Z-1	E_l and/or E_m
Z-2	E_n and/or E_j
Z-3	B
R-1	D
R-2	A and/or A_o
R-3	E_h
R-4	B_s
R-5	B_{n-a} and/or B_{n-b}
B-1	B_{n-c}
B-2	C_h
B-3	C_l

APPENDIX II

The following table lists the blocking types of each zone along with the types in the adjacent zones (to the east and west) that usually appear within one or two days before or after the establishment of the block.

IV	I	II
Any Zonal Type	B-1	Z-3 R-5
Z-1,3,4,6 R-2 B-2	B-2	Z-1,2 R-1,2,3
Any Zonal Type R-2 B-2,3	B-3	R-1,2,3,4 B-1,2,3
Any Zonal Type B-2,3,4	B-4	Any Ridge Type B-1,3
Any Zonal Type B-3	B-5	Z-3 R-5 B-1,3
B-1,3	B-6	B-1
Any Zonal Type B-1,2,3	B-7	Z-1,3 Any Ridge Type B-1,2

I	II	III
R-6,7 B-4,6	B-1	Z-1,3 B-5
B-5,7	B-2	Z-1,2 R-4
Z-1 R-6 B-4,5	B-3	Z-3 R-3 B-3

II	III	IV
R-4	B-1	Z-1
Z-1 R-1,2,3,5 B-3	B-2	B-1,2,3
Z-1 R-4	B-3	Z-3,[illegible]
B-1	B-4	Any Zonal Type
Z-1 B-1	B-5	B-1,2
R-5 B-3	B-6	R-4 B-1
Z-3 R-5 B-3	B-7	B-1

III	IV	I
Z-1,3 B-7 Any Blocking Type	B-1	Z-1 R-6,7 B-7
Z-2,3 R-4,5 B-2,3,6,7	B-2	Any Ridge Type B-2,3,4,7
Z-1,2,3 B-2,3,7	B-3	R-3,5 B-5,7
Z-3	B-4	R-1 B-4

APPENDIX III

The following table is a calendar of the authors' types as developed and classified over the span of years indicated. This list is by no means complete, but it is felt that sufficient data was tabulated to give good representation of each of the types. The calendar is primarily included in hopes that it may be of aid to the reader in familiarizing himself with the types, and further, to provide a source of statistical data for future research in the field.

1948

	SEP				OCT			
Zone	I	II	III	IV	I	II	III	IV
1.	R-3	R-5	Z-1	Z-6	B-5	B-3	R-5	Z-1
2.	"	"	R-2	"	"	"	R-3	"
3.	R-1	"	"	"	"	"	"	"
4.	"	"	"	"	R-1	"	"	R-4
5.	"	"	Z-2	"	"	"	B-3	"
6.	"	B-1	"	"	"	Z-3	"	"
7.	R-6	"	"	Z-3	"	"	"	"
8.	"	"	R-5	"	"	"	"	R-5
9.	"	"	"	"	"	"	R-1	"
10.	"	"	"	R-4	"	"	"	"
11.	R-4	"	B-6	"	"	"	"	Z-6
12.	"	R-1	"	"	R-6	"	Z-2	"
13.	"	"	"	"	"	"	"	"
14.	R-5	"	"	R-2	"	B-1	"	Z-3
15.	"	"	Z-3	"	"	"	"	"
16.	"	R-5	"	"	"	"	"	"
17.	"	"	"	"	"	"	"	Z-4
18.	R-6	"	"	B-4	"	"	R-2	"
19.	"	Z-1	"	"	"	"	"	"
20.	"	"	R-3	R-2	B-5	"	Z-2	"
21.	"	"	"	"	"	Z-3	"	"
22.	"	"	"	"	"	"	"	"
23.	R-5	"	Z-2	"	"	"	"	Z-2
24.	"	Z-3	"	"	R-1	"	R-2	"
25.	R-3	"	"	"	"	R-5	"	"
26.	"	"	R-1	"	"	"	"	"
27.	"	"	"	Z-2	"	"	B-4	"
28.	"	"	"	"	"	"	"	"
29.	B-5	B-3	R-5	R-4	"	"	"	"
30.	"	"	"	"	Z-1	"	"	"
31.	-	-	-	-	"	"	B-6	"

Zone	NOV I	NOV II	NOV III	NOV IV	DEC I	DEC II	DEC III	DEC IV
1.	Z-1	B-3	B-6	Z-4	R-5	Z-3	R-1	Z-3
2.	"	"	"	"	"	"	"	"
3.	"	"	Z-2	Z-3	"	"	"	Z-4
4.	"	"	"	"	"	"	Z-2	"
5.	R-1	"	"	"	"	R-4	"	"
6.	"	"	"	"	Z-1	"	Z-1	"
7.	"	B-1	B-4	R-4	"	"	"	"
8.	R-7	"	"	"	"	"	"	"
9.	"	"	R-5	R-3	B-5	"	"	Z-3
10.	"	"	"	"	"	"	"	"
11.	"	"	"	"	"	"	"	"
12.	Z-1	"	"	"	R-4	R-2	"	"
13.	"	Z-3	"	"	"	"	"	Z-4
14.	"	"	Z-2	"	"	"	"	"
15.	"	"	"	Z-1	"	"	"	"
16.	"	"	"	Z-4	"	B-3	R-5	"
17.	"	B-3	Z-1	"	"	"	"	"
18.	"	"	"	"	"	"	"	"
19.	B-3	"	Z-2	"	R-5	Z-3	B-3	"
20.	"	"	"	"	"	"	"	"
21.	"	R-5	R-1	"	"	"	"	"
22.	"	"	"	B-2	R-3	B-2	"	Z-2
23.	"	"	"	"	"	"	"	"
24.	"	"	"	R-4	"	"	"	"
25.	Z-1	R-2	"	"	B-5	"	"	"
26.	"	"	B-3	"	"	"	"	Z-4
27.	"	"	"	"	"	B-3	"	"
28.	"	Z-3	"	Z-3	"	"	Z-2	"
29.	R-7	"	"	"	"	"	"	"
30.	"	"	"	"	"	Z-3	"	"
31.	-	-	-	-	"	"	"	"

1949

Zone	JAN I	JAN II	JAN III	JAN IV	FEB I	FEB II	FEB III	FEB IV
1.	Z-3	R-2	R-2	Z-3	B-4	R-1	B-4	Z-6
2.	R-6	"	"	"	"	B-3	B-3	"
3.	"	B-1	Z-1	"	"	"	"	"
4.	"	"	"	"	R-2	R-2	"	Z-1
5.	"	R-4	Z-2	"	"	B-3	"	"
6.	B-4	"	"	"	"	"	"	R-4
7.	"	"	"	"	B-2	R-2	Z-2	"
8.	"	B-1	R-4	"	"	"	"	"
9.	"	B-3	"	"	"	"	"	Z-3
10.	"	"	"	Z-2	B-4	"	"	B-3
11.	"	"	Z-2	"	"	R-1	Z-3	"
12.	"	"	"	"	"	"	"	"
13.	"	"	"	R-1	"	R-4	Z-2	R-2
14.	"	R-2	"	"	"	"	"	"
15.	"	"	"	"	R-5	"	"	"
16.	"	B-3	"	"	B-7	R-5	R-5	"
17.	"	"	"	"	"	R-4	"	Z-3
18.	"	"	"	"	"	"	"	"
19.	"	"	"	"	"	B-2	"	"
20.	"	R-2	"	Z-1	"	"	Z-2	Z-4
21.	"	"	"	"	"	B-3	"	"
22.	R-5	"	"	"	Z-1	"	"	"
23.	"	"	"	"	"	"	"	"
24.	"	B-2	R-5	"	"	"	"	"
25.	"	"	"	"	"	"	R-4	Z-1
26.	"	"	"	"	"	R-3	Z-2	"
27.	B-4	"	"	Z-4	"	"	R-4	"
28.	"	"	"	"	"	"	"	"
29.	"	B-3	"	"				
30.	"	"	B-3	"				
31.	"	B-1	"	"				

1949

Zone	MAR				APR			
	I	II	III	IV	I	II	III	IV
1.	Z-1	R-3	R-3	Z-1	Z-4	B-3	B-4	Z-3
2.	"	"	"	Z-3	"	"	B-6	"
3.	B-6	"	"	"	R-3	"	"	R-4
4.	"	"	B-3	Z-2	R-4	"	"	Z-3
5.	B-7	R-5	"	B-3	"	"	"	Z-5
6.	"	"	"	"	B-5	"	"	"
7.	"	"	"	"	"	Z-1	R-2	"
8.	"	B-2	"	"	R-6	"	R-3	"
9.	"	"	"	"	"	"	Z-2	"
10.	"	"	"	"	B-5	B-3	"	Z-2
11.	"	"	R-4	B-2	"	Z-1	"	R-2
12.	"	"	"	"	"	"	"	"
13.	"	"	"	"	"	"	"	R-4
14.	"	"	Z-2	"	"	"	"	Z-1
15.	"	"	"	"	Z-2	"	B-3	"
16.	"	"	R-4	"	"	"	"	Z-3
17.	"	"	"	"	"	"	"	"
18.	"	"	"	"	Z-1	B-3	Z-2	B-1
19.	"	"	"	"	"	"	"	"
20.	R-5	"	Z-2	"	R-3	"	"	"
21.	"	Z-1	"	"	"	"	"	"
22.	"	"	"	"	"	"	"	B-3
23.	"	"	Z-3	"	"	Z-1	"	"
24.	Z-4	B-3	"	"	Z-2	"	"	"
25.	"	"	"	R-3	"	"	"	"
26.	"	"	"	"	"	"	"	"
27.	"	R-4	B-4	"	"	"	"	"
28.	"	"	"	"	Z-1	"	"	"
29.	"	"	B-3	Z-5	"	"	"	Z-2
30.	"	"	"	"	"	"	Z-3	"
31.	"	"	B-4	Z-3				

Zone	SEP I	SEP II	SEP III	SEP IV	OCT I	OCT II	OCT III	OCT IV
1.	R-1	B-3	B-7	B-4	B-5	R-5	Z-3	R-4
2.	"	"	R-1	"	"	"	"	Z-1
3.	"	B-1	"	"	"	Z-3	"	"
4.	B-6	"	"	"	"	"	B-3	"
5.	"	"	"	B-1	R-5	"	Z-3	"
6.	"	"	R-5	"	"	B-1	R-6	"
7.	R-1	"	Z-3	"	"	"	"	R-4
8.	"	R-5	"	"	"	"	B-6	"
9.	"	"	"	"	"	"	"	"
10.	Z-1	"	"	"	"	"	"	"
11.	"	B-3	B-2	"	R-1	Z-3	"	"
12.	"	"	"	"	"	"	"	"
13.	"	"	B-3	Z-4	"	"	R-5	"
14.	"	"	"	"	Z-1	"	"	"
15.	Z-2	"	R-2	"	"	"	Z-1	"
16.	"	R-5	"	B-1	R-6	B-1	"	Z-3
17.	"	"	B-4	"	"	"	"	"
18.	"	"	"	"	"	"	"	"
19.	Z-4	"	"	"	"	"	"	"
20.	"	"	"	"	"	"	"	"
21.	"	"	"	"	"	R-4	"	Z-4
22.	"	"	"	Z-1	B-7	Z-1	B-7	"
23.	R-1	"	B-6	"	"	"	"	"
24.	"	B-3	"	"	"	Z-3	Z-1	Z-2
25.	"	"	"	R-4	"	"	"	"
26.	"	"	Z-3	"	"	"	"	"
27.	"	"	"	"	"	"	"	"
28.	Z-1	"	"	"	"	"	B-3	"
29.	"	B-1	"	"	"	"	"	"
30.	"	"	"	"	Z-1	R-5	"	"
31.	-	-	-	-	"	"	"	"

	NOV				DEC			
Zone	I	II	III	IV	I	II	III	IV
1.	Z-2	B-3	B-3	Z-1	Z-1	Z-3	Z-2	B-2
2.	"	"	Z-3	"	"	R-5	"	R-2
3.	"	"	"	Z-4	"	"	"	"
4.	"	"	"	"	"	"	Z-1	"
5.	"	"	Z-1	"	"	"	"	"
6.	"	"	"	"	R-5	B-3	"	"
7.	"	"	"	"	"	"	R-2	Z-2
8.	"	Z-3	B-7	"	B-4	"	R-3	"
9.	"	"	"	"	"	B-1	"	"
10.	"	"	"	"	R-5	"	"	"
11.	R-3	"	"	B-3	"	"	Z-3	"
12.	"	R-5	"	"	"	"	"	"
13.	B-5	"	"	"	"	"	Z-2	B-3
14.	"	"	"	"	"	Z-1	"	"
15.	"	"	"	"	B-4	"	"	"
16.	"	"	B-6	"	"	"	"	"
17.	"	"	B-7	"	"	"	"	"
18.	"	"	"	"	"	"	"	B-2
19.	B-7	"	"	"	"	B-1	"	"
20.	"	"	"	"	"	"	"	"
21.	"	"	"	"	"	"	R-5	"
22.	"	Z-3	"	B-1	"	R-5	"	"
23.	"	"	"	"	"	"	"	"
24.	Z-1	"	R-3	"	"	"	"	"
25.	"	"	"	"	"	"	"	"
26.	"	"	R-4	B-2	B-3	"	Z-2	Z-1
27.	"	"	"	"	"	R-4	"	"
28.	"	"	"	"	"	"	B-1	"
29.	"	"	Z-2	"	"	"	"	"
30.	"	"	"	"	R-4	R-1	R-6	"
31.					"	"	B-7	"

1950

	JAN				FEB			
Zone	I	II	III	IV	I	II	III	IV
1.	B-4	B-1	Z-3	B-2	B-1	B-3	B-7	Z-6
2.	"	"	"	"	"	"	B-6	"
3.	"	"	R-4	"	"	B-5	"	"
4.	"	"	B-7	R-2	"	"	"	"
5.	B-2	R-1	"	"	"	"	B-7	"
6.	"	"	"	"	"	R-4	"	Z-2
7.	"	"	"	"	"	"	"	"
8.	"	"	R-1	"	"	"	Z-2	"
9.	"	"	"	Z-6	"	"	"	"
10.	"	"	"	"	"	"	"	"
11.	"	R-2	R-5	"	"	R-5	Z-1	"
12.	"	"	"	"	"	"	"	"
13.	B-3	"	"	Z-1	"	"	"	"
14.	"	"	Z-2	"	"	"	R-5	"
15.	"	"	"	"	"	"	"	"
16.	"	R-3	R-3	"	"	"	"	"
17.	"	"	B-3	"	Z-1	R-4	"	Z-1
18.	"	"	"	"	"	"	"	"
19.	B-2	"	"	"	"	"	"	"
20.	"	"	"	"	"	"	Z-1	"
21.	"	R-1	"	"	"	"	B-1	"
22.	"	"	"	"	"	"	"	"
23.	"	"	"	Z-6	"	"	Z-1	"
24.	"	"	"	"	"	Z-3	"	Z-3
25.	B-3	"	"	"	"	"	"	"
26.	"	"	R-5	"	R-1	"	Z-3	"
27.	"	"	"	"	"	"	"	"
28.	"	R-2	"	"	R-6	B-1	B-5	"
29.	"	"	B-1	"				
30.	"	"	"	"				
31.	"	"	B-7	"				

	MAR				APR			
Zone	I	II	III	IV	I	II	III	IV
1.	B-7	B-1	B-5	Z-3			Z-2	
2.	"	Z-3	B-6	"			R-3	
3.	Z-1	"	B-7	Z-4			"	
4.	"	"	R-5	"			Z-2	
5.	B-7	"	"	Z-3			"	
6.	"	R-2	"	"			R-6	
7.	"	"	"	R-2			B-7	
8.	"	"	"	"			"	
9.	"	R-1	"	"			"	
10.	"	"	R-3	R-4			"	
11.	"	"	"	"			R-2	
12.	"	"	"	"			"	
13.	Z-4	Z-3	"	"			"	
14.	"	"	R-1	Z-3			Z-3	
15.	"	"	B-6	"			"	
16.	Z-1	B-3	"	R-2			"	
17.	"	"	B-7	"			R-2	
18.	"	"	"	"			"	
19.	"	"	"	B-5			Z-3	
20.	"	Z-3	"	"			"	
21.	"	"	"	Z-2			"	
22.	"	"	R-5	"			"	
23.	Z-3	"	"	"			R-3	
24.	"	R-4	"	Z-4			"	
25.	"	"	B-3	"			"	
26.	"	"	"	Z-4			"	
27.	"	"	"	"			"	
28.	"	"	"	"			"	
29.	B-5	"	R-3	Z-2			R-5	
30.	"	"	Z-3	"			"	
31.	"	"	Z-2	"			"	

Zone	SEP I	SEP II	SEP III	SEP IV	OCT I	OCT II	OCT III	OCT IV
1.	R-5	Z-3	Z-3	R-2	R-6	R-5	R-3	Z-3
2.	R-4	"	R-5	"	"	"	"	"
3.	"	"	R-3	"	"	R-3	R-1	"
4.	"	"	"	R-4	"	"	"	"
5.	"	R-1	"	"	"	"	Z-1	Z-4
6.	"	"	"	"	"	"	"	"
7.	"	R-2	R-4	"	R-1	R-5	R-2	B-1
8.	"	"	"	Z-5	"	"	Z-3	"
9.	"	"	R-2	"	"	Z-3	R-2	Z-4
10.	B-1	B-1	R-4	"	"	"	B-3	"
11.	"	"	"	R-1	"	"	"	"
12.	"	"	R-3	"	B-2	B-1	R-6	"
13.	R-1	"	"	"	"	"	B-[illegible]	"
14.	"	R-5	B-3	Z-2	"	"	"	"
15.	"	"	"	"	R-6	"	"	"
16.	"	Z-3	Z-3	"	"	B-3	"	"
17.	"	"	R-3	"	"	"	"	"
18.	"	"	"	"	"	"	"	B-4
19.	R-6	R-5	"	"	Z-2	R-5	"	"
20.	"	"	R-4	R-6	R-6	"	"	Z-4
21.	R-7	"	"	"	"	Z-3	Z-1	Z-3
22.	"	"	Z-2	"	"	"	R-1	"
23.	Z-1	"	"	Z-3	"	"	"	Z-4
24.	"	"	"	"	B-5	"	"	"
25.	"	"	"	"	"	"	R-2	"
26.	"	"	Z-1	"	"	"	"	"
27.	"	Z-3	"	"	"	R-5	R-1	"
28.	"	"	R-3	"	B-7	"	"	"
29.	R-1	"	"	"	"	Z-3	R-2	Z-1
30.	"	R-5	"	"	Z-1	"	"	Z-4
31.					"	"	B-7	"

Zone	NOV I	NOV II	NOV III	NOV IV	DEC I	DEC II	DEC III	DEC IV
1.	R-3	R-5	B-7	Z-4	Z-2	Z-3	B-1	Z-2
2.	Z-1	"	"	"	"	"	B-4	B-4
3.	"	"	Z-3	"	Z-3	"	"	"
4.	R-1	B-3	R-5	B-2	"	"	B-3	Z-2
5.	"	"	R-4	"	"	Z-2	"	"
6.	"	"	"	"	"	"	"	R-4
7.	R-4	"	R-3	"	Z-1	"	R-5	"
8.	"	R-5	"	"	"	"	Z-3	"
9.	"	"	R-4	"	"	"	"	"
10.	"	"	"	"	R-6	"	"	"
11.	"	Z-3	R-3	B-3	"	"	Z-2	"
12.	"	"	R-4	"	"	R-5	Z-1	Z-3
13.	R-5	"	"	"	B-1	"	R-2	"
14.	"	"	B-2	"	"	"	"	B-3
15.	"	R-5	"	"	"	"	Z-1	"
16.	Z-1	"	"	"	Z-2	B-2	"	"
17.	"	"	"	"	"	"	"	"
18.	"	B-1	"	"	"	"	Z-2	"
19.	"	"	"	"	"	"	"	"
20.	R-7	"	B-7	B-1	"	B-3	Z-3	"
21.	"	"	"	"	Z-1	"	"	"
22.	"	"	Z-1	"	"	"	"	"
23.	"	"	"	"	"	"	"	"
24.	"	"	"	"	"	"	"	"
25.	B-7	"	"	"	"	Z-3	"	Z-3
26.	"	"	"	"	"	"	R-2	"
27.	R-4	R-2	"	B-2	"	"	"	"
28.	"	"	B-1	"	"	"	R-3	"
29.	Z-2	R-1	"	"	"	"	"	"
30.	"	"	"	"	"	"	"	"
31.					"	R-5	"	Z-6

1953

Zone	JAN I	JAN II	JAN III	JAN IV	FEB I	FEB II	FEB III	FEB IV
1.	Z-1	R-5	R-4	Z-6	Z-4	R-4	B-3	B-2
2.	"	"	"	"	"	"	"	"
3.	"	Z-1	B-5	Z-3	"	"	"	"
4.	B-7	"	"	"	"	"	B-4	"
5.	"	"	B-2	B-1	Z-1	"	R-4	"
6.	"	"	"	"	"	Z-3	"	B-3
7.	"	"	"	"	"	"	"	"
8.	"	R-4	"	"	"	B-1	B-7	"
9.	"	"	R-5	Z-3	"	"	"	"
10.	"	"	"	"	Z-4	"	"	"
11.	Z-4	Z-1	"	"	"	"	R-3	"
12.	"	"	"	B-4	"	R-5	B-2	"
13.	"	"	B-2	"	"	"	"	"
14.	"	"	"	"	Z-1	Z-3	"	R-2
15.	"	Z-2	Z-3	"	"	"	Z-3	"
16.	"	"	"	R-4	"	"	"	"
17.	"	"	"	"	"	"	"	"
18.		"	B-3	Z-2	R-7	B-1	Z-2	Z-6
19.		Z-3	"	"	"	"	"	"
20.		"	"	"	"	"	"	"
21.		"	R-5	"	"	"	R-5	"
22.	B-3	R-5	"	"	"	"	"	"
23.		"	"	R-2	"	"	"	"
24.		R-1	Z-1	"	"	"	"	"
25.		"	"	"	"	"	B-3	B-1
26.		"	Z-3	"	B-5	"	B-6	"
27.		"	"	"	"	"	B-2	
28.	Z-4	R-4	R-5	"	B-6	R-2	B-3	
29.		"	"	B-2				
30.		"	R-2	"				
31.		"	R-3	"				

	MAR				APR			
Zone	I	II	III	IV	I	II	III	IV
1.	B-6	R-2	B-3	B-1	Z-1	B-3	Z-2	Z-3
2.	"	"	"	Z-3	"	R-5	"	"
3.	"	B-1	"	"	"	"	"	"
4.	"	Z-3	"	"	"	"	"	"
5.	"	"	"	"	B-4	R-1	B-7	B-3
6.	"	"	"	"	"	"	Z-1	"
7.	R-3	"	"	"	"	"	"	"
8.	"	R-4	"	"	B-3	B-2	"	R-2
9.	"	"	"	"	"	"	"	"
10.	"	"	"	"	"	"	"	"
11.	B-5	R-1	"	"	"	"	R-1	"
12.	"	"	"	Z-6	"	"	"	[illegible]
13.	"	Z-2	"	"	"	R-3	R-3	"
14.	"	"	"	"	B-7	"	"	R-2
15.	Z-2	"	"	B-1	"	"	"	"
16.	"	"	B-6	"	"	"	B-2	"
17.	"	"	"	"	"	"	"	"
18.	"	Z-1	"	"	"	"	"	Z-2
19.	R-1	"	B-5	"	"	"	"	"
20.	"	"	"	"	Z-1	Z-3	"	"
21.	"	"	"	"	"	"	"	"
22.	R-5	"	B-3	"	"	"	R-2	"
23.	"	"	"	"	Z-2	"	"	"
24.	"	"	"	R-3	"	Z-1	B-7	[illegible]
25.	R-6	"	R-5	"	"	"	R-2	"
26.	"	Z-3	Z-2	"	"	"	"	"
27.	"	"	"	[illegible]	"	"	"	"
28.		"	"	"	"	"	Z-1	"
29.	"	"	"	"	Z-1	"	"	"
30.	Z-4	"	Z-1	"	"	"	"	"
31.	"	B-3	"	Z-3				

Zone	SEP I	SEP II	SEP III	SEP IV	OCT I	OCT II	OCT III	OCT IV
1.	R-6	B-1	Z-3	R-2	Z-3	R-1	Z-3	Z-3
2.	"	"	"	"	Z-1	Z-3	"	Z-1
3.	"	"	"	R-4	"	"	B-3	"
4.	"	Z-3	B-3	"	"	R-5	"	"
5.	"	"	"	"	B-4	"	"	Z-5
6.	"	"	"	"	"	"	"	"
7.	"	"	"	"	"	"	"	"
8.	Z-1	"	Z-3	"	Z-1	"	"	"
9.	"	"	R-4	"	"	"	Z-3	"
10.	"	"	"	"	R-5	"	"	"
11.	R-6	R-5	"	"	"	"	B-6	R-3
12.	"	"	"	"	"	B-3	R-2	"
13.	"	"	B-3	"	R-6	"	R-3	B-1
14.	"	"	B-6	Z-5	"	"	"	"
15.	"	"	"	"	Z-1	R-5	"	"
16.	"	Z-3	"	"	"	"	B-5	
17.	"	"	"	"	"	Z-3	"	"
18.	"	"	"	R-3	R-1	"	"	"
19.	"	"	B-7	"	"	"	"	R-5
20.	B-5	B-3	"	"	"	B-1	B-3	"
21.	"	"	Z-1	R-5	R-7	"	B-6	"
22.	"	"	"	"	"	B-3	"	"
23.	"	"	"	"	"	"	"	B-1
24.	"	Z-3	R-4	"	"	"	"	"
25.	"	"	Z-3	"	"	R-5	"	"
26.	B-1	"	"	Z-5	Z-3	"	"	"
27.	"	"	B-6	"	"	"	"	B-2
28.	"	"	"	Z-3	R-1	Z-3	B-7	"
29.	"	R-1	Z-2	"	"	"	"	"
30.	"	"	"	"	R-6	"	"	"
31.	-	-	-	-	"	"	"	"

1953

Zone	NOV I	NOV II	NOV III	NOV IV	DEC I	DEC II	DEC III	DEC IV
1.	B-5	Z-3	B-7	B-2	R-1	Z-3	R-5	R-2
2.	R-3	"	"	"	Z-1	"	R-2	"
3.	"	Z-1	"	"	"	"	"	"
4.	"	"	"	"	"	"	R-3	"
5.	"	"	"	"	"	"	"	"
6.	"	"	Z-3	B-3	"	"	B-3	"
7.	B-7	R-1	"	"	"	R-4	"	R-3
8.	"	"	"	"	"	"	B-6	"
9.	"	R-4	"	"	"	"	B-7	R-4
10.	Z-2	"	R-5	"	R-1	"	"	"
11.	"	Z-3	"	B-2	"	Z-3	"	"
12.	"	"	"	"	"	R-5	"	B-1
13.	"	"	"	"	Z-1	"	"	"
14.	"	"	"	"	"	"	"	"
15.	"	R-4	B-5	R-2	"	"	"	"
16.	Z-1	"	"	"	"	"	B-6	"
17.	"	"	R-5	"	"	R-4	"	"
18.	"	B-3	"	Z-6	"	"	R-5	"
19.	"	"	"	"	"	"	"	"
20.	"	"	"	"	R-6	"	"	"
21.	"	"	"	"	"	R-5	"	"
22.	"	Z-2	"	"	"	"	"	"
23.	"	"	B-3	"	"	"	Z-3	"
24.	"	"	"	"	"	"	"	"
25.	"	R-4	Z-3	"	B-6	"	"	"
26.	"	"	"	"	"	B-1	"	B-3
27.	"	Z-3	"	"	"	"	"	"
28.	"	"	"	Z-4	"	"	"	"
29.	R-1	"	"	"	"	"	B-2	Z-6
30.	"	"	Z-2	"	Z-3	Z-3	"	"
31.					"	"	"	"

1954

	JAN				FEB			
Zone	I	II	III	IV	I	II	III	IV
1.	Z-3	Z-2	B-3	Z 6	Z-4	Z-3	B-5	R-4
2.	Z-1	"	"	"	"	R-5	B-2	"
3.	"	"	R-3	"	R-6	"	"	"
4.	"	"	"	"	"	"	"	"
5.	"	"	Z-3	B-1	"	"	"	"
6.	"	"	B-3	"	"	"	"	"
7.	"	"	"	B-3	"	"	B-7	B-1
8.	R-6	R-5	"	"	"	B-3	"	"
9.	"	"	R-4	"	B-7	"	"	"
10.	B-6	B-3	"	"	"	"	"	"
11.	"	"	"	"	"	Z-1	"	"
12.	"	"	Z-1	"	"	"	"	"
13.	"	R-1	"	B-1	"	"	B-5	"
14.	B-3	"	"	"	Z-4	"	"	"
15.	"	"	B-7	"	"	"	"	"
16.	"	"	"	B-2	"	"	"	Z-6
17.	"	"	R-5	"	"	"	"	"
18.	"	"	"	"	"	Z-3	"	"
19.	"	"	"	"	"	"	B-7	R-3
20.	"	"	R-6	"	"	"	"	"
21.	"	"	"	B-3	Z-1	"	"	"
22.	"	"	B-3	"	"	R-5	"	B-2
23.	"	"	"	"	"	"	"	"
24.	"	"	"	" "	R-1	"	"	"
25.	"	"	"	"	"	Z-2	R-2	"
26.	"	"	B-5	Z-6	"	"	"	"
27.	"	"	"	"	"	B-1	R-3	B-3
28.	"	Z-2	"	"	"	"	"	"
29.	Z-4	"	"	"				
30.	"	Z-3	"	"				
31.	"	"	"	"				

	MAR				APR			
Zone	I	II	III	IV	I	II	III	IV
1.	R-1	B-1	R-3	B-3	B-2	Z-1	B-7	Z-4
2.	"	B-3	"	"	"	"	"	"
3.	"	"	"	"	"	"	Z-3	[illegible]
4.	B-5	"	"	"	"	Z-2	R-5	"
5.	"	"	"	"	"	"	"	"
6.	"	"	Z-1	"	"	"	B-3	"
7.	"	"	"	"	"	"	"	"
8.	R-3	Z-3	"	"	B-1	Z-3	B-5	"
9.	"	"	B-6	"	"	"	"	"
10.	R-5	"	"	"	"	"	"	Z-4
11.	"	B-3	"	"	"	"	Z-3	"
12.	"	"	B-3	"	"	"	"	B-3
13.	"	"	"	Z-4	"	"	R-4	"
14.	B-2	R-2	"	"	"	R-3	"	"
15.	"	"	B-6	"	B-5	Z-3	B-3	Z-2
16.	"	"	"	Z-3	"	"	"	"
17.	"	"	"	"	R-1	R-4	"	"
18.	"	"	"	R-4	B-3	"	"	Z-3
19.	"	"	"	"	"	R-1	B-4	"
20.	"	"	"	"	"	"	"	"
21.	B-4	"	"	Z-5	"	"	"	R-2
22.	"	"	R-3	"	"	B-1	"	"
23.	"	B-1	"	"	"	"	"	"
24.	"	"	R-4	"	"	"	"	"
25.	B-7	Z-1	"	Z-5	B-4	Z-1	"	"
26.	"	"	R-1	"	"	"	"	"
27.	"	"	"	"	"	"	"	"
28.	"	R-3	B-6	Z-1	B-5	"	"	"
29.	"	"	"	"	"	"	Z-2	Z-3
30.	B-2	"	B-7	"	"	B-1	Z-1	"
31.	"	"	"	"				

Zone	SEP I	SEP II	SEP III	SEP IV	OCT I	OCT II	OCT III	OCT IV
1.	B-7	Z-3	R-5	R-2	B-3	B-1	R-5	B-3
2.	"	"	B-6	"	"	Z-1	"	"
3.	"	B-1	"	R-4	"	"	"	"
4.	"	"	B-7	"	"	"	Z-3	"
5.	"	Z-3	"	"	Z-4	B-3	R-5	"
6.	"	"	R-6	"	"	"	B-3	Z-6
7.	R-4	"	Z-1	"	"	Z-3	B-5	"
8.	"	"	Z-2	"	"	"	"	"
9.	"	"	"	"	"	"	Z-3	B-4
10.	R-6	R-2	"	"	"	"	"	"
11.	"	"	Z-1	"	"	"	"	"
12.	"	"	Z-3	R-5	"	"	R-5	"
13.	B-4	"	"	"	Z-1	R-5	"	"
14.	"	"	"	"	"	"	"	"
15.	"	B-1	"	B-4	"	"	Z-1	R-4
16.	"	"	Z-2	"	"	"	"	"
17.	"	R-2	"	"	"	"	Z-2	"
18.	"	"	"	"	"	"	"	"
19.	"	"	"	"	"	"	"	"
20.	Z-4	R-5	"	"	"	"	"	"
21.	"	"	"	Z-3	R-1	Z-3	Z-1	"
22.	"	"	Z-3	"	"	"	"	"
23.	"	"	"	"	"	R-5	"	"
24.	"	"	"	B-3	"	"	R-3	Z-1
25.	"	"	"	"	"	"	"	"
26.	B-4	"	Z-2	"	"	"	R-6	B-3
27.	"	B-1	"	"	"	"	"	"
28.	"	"	Z-3	"	R-6	"	R-2	"
29.	"	"	"	"	"	"	"	"
30.	"	"	R-5	"	R-6	B-1	R-1	"
31.					"	"	"	"

Zone	NOV I	NOV II	NOV III	NOV IV	DEC I	DEC II	DEC III	DEC IV
1.	Z-1	B-3	Z-3	Z-3	R-6	R-2	Z-3	B-3
2.	"	"	"	"	R-2	"	"	"
3.	"	"	R-1	"	R-3	R-1	"	"
4.	"	R-5	R-2	"	"	"	"	"
5.	"	"	R-3	"	"	R-4	R-3	"
6.	Z-2	"	B-7	"	"	"	"	"
7.	"	"	"	"	"	"	R-2	R-1
8.	"	"	Z-1	"	Z-2	R-5	"	"
9.	"	Z-3	Z-2	"	"	"	"	"
10.	Z-1	"	"	"	"	"	Z-1	B-3
11.	"	"	"	"	"	"	"	"
12.	"	Z-1	"	"	B-5	Z-3	"	"
13.	"	"	B-3	"	"	"	"	"
14.	Z-2	"	"	"	"	"	"	"
15.	"	"	"	"	R-7	"	Z-3	Z-4
16.	"	R-5	"	"	"	B-3	"	"
17.	Z-1	"	"	"	"	"	"	"
18.	"	"	B-5	"	"	"	"	B-2
19.	"	"	B-7	B-2	"	R-5	"	"
20.	R-6	"	"	"	Z-1	"	"	"
21.	"	"	"	"	"	"	"	"
22.	"	"	"	"	"	"	"	"
23.	R-6	"	"	"	B-1	R-1	R-3	"
24.	"	"	"	"	"	"	"	"
25.	"	Z-3	"	"	"	Z-2	Z-3	"
26.	"	"	"	"	"	"	"	"
27.	R-5	"	Z-1	B-3	R-5	"	R-5	"
28.	"	"	"	"	"	"	"	"
29.	"	R-2	"	"	"	"	"	"
30.	B-4	"	B-7	"	"	"	B-5	"
31.					"	"	"	"

Zone	JAN I	JAN II	JAN III	JAN IV	FEB I	FEB II	FEB III	FEB IV
1.	R-5	Z-2	B-3	B-2	R-1	B-1	Z-1	Z-3
2.	"	B-1	"	B-1	"	"	"	"
3.	"	"	"	"	"	"	"	Z-4
4.	"	"	B-4	"	R-2	"	"	"
5.	"	"	"	R-4	"	R-4	"	"
6.	R-7	"	R-3	"	"	"	R-6	"
7.	"	"	"	"	"	"	"	"
8.	"	"	Z-1	"	"	"	R-3	"
9.	"	"	"	"	"	B-1	"	"
10.	"	B-3	"	Z-2	"	"	"	Z-1
11.	Z-1	"	"	"	R-3	R-5	B-1	"
12.	"	"	"	"	"	"	"	"
13.	"	Z-1	"	"	"	"	"	"
14.	"	"	"	"	B-5	B-3	"	"
15.	"	Z-2	"	R-2	"	"	"	R-2
16.	"	"	R-3	"	"	"	"	"
17.	"	"	"	"	B-4	"	R-4	"
18.	"	R-2	"	"	"	"	"	"
19.	"	B-1	Z-1	"	"	B-1	"	"
20.	R-6	"	"	Z-2	"	"	Z-1	Z-3
21.	"	"	"	"	"	"	"	"
22.	Z-1	"	R-3	"	B-2	R-2	"	"
23.	"	"	B-5	"	"	"	B-5	B-2
24.	"	B-3	Z-3	"	"	"	"	"
25.	R-6	"	"	"	"	R-1	"	"
26.	"	"	B-6	Z-3	"	"	"	"
27.	"	B-2	"	"	"	R-2	"	"
28.	Z-1	"	Z-1	"	"	"	"	"
29.	"	"	"	"				
30.	"	Z-3	"	"				
31.	"	"	"	"				

Zone	MAR I	MAR II	MAR III	MAR IV	APR I	APR II	APR III	APR IV
1.	B-7	R-2	B-2	B-2	Z-1	Z-3	B-3	R-3
2.	"	"	"	"	"	"	R-5	"
3.	"	"	"	"	R-7	"	"	"
4.	B-6	B-1	B-3	"	"	R-5	"	"
5.	"	"	"	"	"	"	"	B-2
6.	"	"	"	Z-6	"	"	"	"
7.	B-4	Z-3	R-4	"	Z-1	"	Z-3	"
8.	"	"	"	"	"	Z-3	"	"
9.	"	Z-2	"	B-3	"	"	"	B-1
10.	B-5	"	B-3	"	R-3	"	"	"
11.	"	"	"	"	"	"	"	"
12.	"	"	"	Z-3	"	"	B-3	B-2
13.	B-6	B-1	"	"	R-4	"	"	"
14.	"	"	"	Z-4	"	R-2	B-4	Z-2
15.	"	"	"	"	"	"	"	"
16.	"	"	B-4	Z-3	"	"	B-3	"
17.	"	"	"	"	"	"	"	"
18.	"	"	"	R-2	B-5	"	"	"
19.	B-1	"	Z-1	"	"	"	"	B-3
20.	"	"	"	"	"	"	B-4	"
21.	B-5	"	"	"	"	"	"	"
22.	"	"	"	B-3	"	Z-3	R-4	R-2
23.	"	R-5	"	"	"	"	"	"
24.	"	"	"	"	"	"	"	"
25.	"	"	Z-2	"	R-4	Z-1	B-4	"
26.	"	"	"	Z-3	"	"	Z-2	"
27.	"	"	B-4	"	"	"	"	"
28.	Z-1	Z-1	B-3	"	"	R-2	"	Z-4
29.	"	"	"	"	"	"	B-6	"
30.	"	Z-3	"	R-3	"	"	"	"
31.		"	"	"				

Zone	NOV I	NOV II	NOV III	NOV IV	DEC I	DEC II	DEC III	DEC IV
1.	Z-1	Z-2	R-1	R-3	B-2	Z-1	Z-3	Z-1
2.	"	"	"	"	"	"	"	"
3.	"	"	"	"	Z-1	"	Z-2	"
4.	"	"	"	R-4	"	"	R-5	"
5.	"	"	"	"	"	"	"	"
6.	R-6	R-5	"	"	"	Z-3	"	"
7.	"	"	"	"	"	"	"	"
8.	"	"	"	"	B-2	"	Z-1	"
9.	"	B-1	R-2	Z-4	"	"	"	"
10.	"	"	"	"	"	R-5	"	"
11.	"	"	"	"	"	"	R-6	"
12.	"	R-2	B-4	"	"	B-1	B-3	"
13.	"	"	"	"	"	"	"	R-3
14.	"	"	B-3	Z-6	"	R-1	"	"
15.	"	"	"	"	"	"	Z-1	"
16.	R-2	"	"	"	"	"	"	"
17.	"	R-4	"	"	"	Z-2	"	"
18.	"	"	"	"	"	"	B-4	B-1
19.	R-4	"	"	Z-1	"	"	"	"
20.	"	"	"	"	"	"	B-6	"
21.	Z-2	"	"	"	"	"	"	B-2
22.	"	Z-1	R-3	"	"	"	Z-2	"
23.	B-7	"	"	"	R-3	R-1	"	"
24.	"	"	"	"	"	"	"	"
25.	"	"	R-5	"	"	"	R-5	"
26.	"	"	"	"	R-2	"	"	"
27.	"	R-5	"	"	"	B-1	"	"
28.	B-2	"	Z-3	"	"	"	Z-2	"
29.	"	Z-1	"	"	"	R-3	"	"
30.	"	"	"	"	B-2	"	[illegible]	"
31.					"	"	"	"

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Zone	JAN I	JAN II	JAN III	JAN IV	FEB I	FEB II	FEB III	FEB IV
1.	B-2	R-1	R-5	B-2	R-5	B-2	B-5	B-2
2.	"	"	"	"	"	"	"	"
3.	"	"	"	"	"	"	"	"
4.	"	"	B-2	"	"	"	B-3	"
5.	"	"	"	B-1	B-5	B-1	"	"
6.	"	"	"	"	"	"	"	"
7.	"	"	"	"	"	R-[illegible]	"	"
8.	"	Z-1	R-1	"	"	"	R-4	"
9.	"	"	"	"	"	"	"	"
10.	"	"	"	"	"	"	B-2	"
11.	"	"	"	B-2	"	R-2	"	"
12.	"	"	"	"	R-5	"	"	"
13.	"	"	R-2	"	"	"	"	"
14.	"	"	"	"	"	"	"	"
15.	"	"	"	"	"	"	R-3	"
16.	"	"	"	"	"	"	"	"
17.	"	Z-2	Z-1	R-2	"	"	"	B-3
18.	"	"	"	"	R-3	"	B-4	"
19.	"	"	"	"	"	R-1	"	"
20.	"	"	"	"	"	"	B-2	"
21.	"	Z-1	"	"	"	"	"	"
22.	"	"	"	"	"	"	"	"
23.	"		"	"	"	R-2	B-4	B-1
24.	"		"	Z-6	"	"	"	"
25.	"	"	R-6	"	R-5	Z-2	B-3	"
26.	"	"	"	"	"	"	"	B-4
27.	"	B-2	B-5	B-2	"	Z-2	Z-2	"
28.	"	"	"	"	"	"	"	"
29.	R-2	"	"	"	"	"	Z-2	"
30.	"	"	B-1	B-1				
31.	"	"	"	"				

Zone	MAR I	MAR II	MAR III	MAR IV	APR I	APR II	APR III	APR IV
1.	R-5	Z-2	Z-3	B-4	B-5	B-1	B-3	R-2
2.	Z-3	"	"	Z-1	"	"	R-4	"
3.	"	"	"	"	"	"	"	"
4.	"	"	"	"	"	Z-2	"	"
5.	R-5	R-2	R-5	R-2	"	"	"	Z-2
6.	"	Z-2	"	"	"	Z-3	R-5	"
7.	"	"	"	"	"	"	"	"
8.	B-6	R-2	"	"	"	"	"	"
9.	"	"	"	Z-6	"	R-2	"	"
10.	"	"	B-5	"	R-6	B-3	R-6	"
11.	"	B-1	"	"	"	"	"	"
12.	"	"	"	B-1	Z-2	"	R-3	Z-3
13.	"	"	"	"	"	"	"	"
14.	"	B-3	B-7	"	"	"	"	"
15.	"	"	"	"	"	R-5	"	"
16.	B-5	"	"	"	"	"	"	"
17.	"	"	"	[illegible]	R-3	B-3	B-3	"
18.	"	"	"	"	"	"	"	Z-4
19.	B-7	"	"	"	"	"	"	"
20.	"	Z-1	"	"	B-4	"	R-5	"
21.	"	"	B-6	"	"	"	"	Z-3
22.	"	Z-2	"	"	B-7	"	"	"
23.	R-3	"	B-7	"	"	B-2	"	"
24.	"	"	"	"	"	"	R-2	Z-2
25.	"	Z-1	"	"	"	"	"	"
26.	Z-1	"	R-2	"	"	"	"	"
27.	"	"	B-3	"	"	B-1	R-4	"
28.	"	"	"	Z-6	"	"	"	"
29.	"	"	"	"	"	"	"	"
30.	R-5	"	"	"	"	"	"	Z-3
31.	"	"	"	R-5				

Zone	SEP I	SEP II	SEP III	SEP IV	OCT I	OCT II	OCT III	OCT IV
1.	R-1	Z-3	B-4	Z-4	Z-4	Z-2	R-2	R-5
2.	"	B-1	"	R-4	"	"	"	" "
3.	"	"	"	"	"	"	R-3	Z-1
4.	B-5	"	R-1	"	B-2	"	"	"
5.	"	"	"	"	"	"	"	"
6.	R-4	R-1	R-2	B-4	B-5	R-5	R-5	B-3
7.	"	"	"	"	"	"	"	"
8.	"	"	"	"	"	"	"	"
9.	B-4	B-3	B-5	"	R-6	"	"	"
10.	"	"	"	"	"	"	"	Z-2
11.	"	"	Z-3	"	"	Z-3	"	"
12.	"	B-1	"	"	Z-2	"	"	"
13.	"	"	"	"	"	"	"	Z-4
14.	"	"	"	"	"	"	"	"
15.	"	"	B-3	Z-6	Z-1	"	B-3	R-2
16.	R-6	R-5	"	"	"	"	"	"
17.	"	"	"	"	"	"	B-6	"
18.	"	"	"	"	"	"	Z-2	Z-4
19.	"	Z-2	"	"	R-3	"	"	.
20.	R-6	"	R-1	R-5	"	Z-2	"	"
21.	"	"	"	"	"	"	R-5	Z-1
22.	"	Z-3	"	"	R-3	"	"	"
23.	B-5	"	B-3	R-4	Z-2	"	Z-2	"
24.	"	"	"	"	"	"	"	R-5
25.	Z-1	"	B-6	"	R-5	R-1	R-4	"
26.	"	R-2	"	"	"	"	"	Z-1
27.	Z-3	"	Z-2	"	"	"	"	B-2
28.	"	Z-3	"	"	Z-2	Z-2	B-5	"
29.	"	"	"	R-5	"	"	"	"
30.	"	"	"	"	"	"	B-3	"
31.					Z-4	"	"	"

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Zone	NOV I	NOV II	NOV III	NOV IV	DEC I	DEC II	DEC III	DEC IV
1.	R-1	B-3	B-3	R-2	B-2	[illegible]	R-5	R-1
2.	"	"	"	"	"	"	"	"
3.	"	"	R-3	"	"	Z-1	"	"
4.	"	Z-2	"	B-4	"	"	"	R-[illegible]
5.	"	"	"	"	"	"	"	"
6.	R-6	"	R-[illegible]	"	"	"	"	"
7.	"	"	"	"	"	Z-2	"	"
8.	"	R-5	B-3	[illegible]	"	"	"	"
9.	"	"	B-[illegible]	"	"	"	Z-2	"
10	Z-[illegible]	Z-3	R-3	"	"	"	"	"
11.	"	"	"	"	[illegible]	"	"	"
12.	"	"	"	"	"	"	"	"
13	"	B-[illegible]	"	"	[illegible]-5	"	"	"
14	"	"	[illegible]	"	"	"	"	"
15	"	Z-1	"	"	"	"	"	"
16	R-[illegible]	"	"	"	Z-[illegible]	"	B-[illegible]	"
17.	"	"	"	"	"	Z-1	"	"
18.	"	B-1	B-[illegible]	"	"	"	"	"
19.	"	"	"	"	"	"	Z-2	"
20	"	"	"	"	"	"	"	Z-6
21	"	[illegible]	"	[illegible]	"	B-[illegible]	B-5	"
22	"	"	"	"	"	"	"	"
23.	R-5	"	"	"	"	Z-[illegible]	"	"
24	"	"	[illegible]	R-[illegible]	"	[illegible]	"	"
25	"	"	"	"	"	"	[illegible]	"
26	"	"	"	"	R-[illegible]	"	"	B-1
27	"	B-2	"	"	"	"	"	"
28	"	"	R-3	"	"	"	Z-1	"
29	B-[illegible]	[illegible]	"	[illegible]	[illegible]	"	"	"
30	"	"	B-[illegible]	"	"	Z-[illegible]	"	"
31					"	"	"	"

	JAN				FEB			
Zone	I	II	III	IV	I	II	III	IV
1.	R-5	Z-1	B-7	B-1	B-2	R-1	B-6	B-2
2.	"	"	"	"	"	"	"	"
3.	"	"	R-5	"	"	"	"	"
4.	B-4	B-3	"	"	"	Z-2	"	"
5.	"	"	"	Z-3	B-4	"	"	R-2
6.	"	R-1	"	"	"	B-3	Z-2	"
7.	"	"	"	"	"	"	"	"
8.	"	R-2	"	"	"	"	Z-1	"
9.	"	"	R-3	Z-2	"	Z-2	"	Z-2
10.	'	R-3	B-3	"	"	"	"	"
11.	'	"	"	"	Z-4	"	"	"
12.	"	"	"	"	"	"	"	"
13.	"	"	B-2	B-2	"	"	"	"
14.	"	"	"	"	B-7	B-1	"	B-3
15.	"	"	B-3	"	"	"	"	"
16.	"	"	"	"	"	"	R-2	"
17.	B-2	"	"	B-4	"	"	"	"
18.	"	"	"	"	"	R-3	R-3	"
19.	"	"	"	"	"	"	"	"
20.	"	"	B-4	"	"	"	"	"
21.	"	"	"	"	"	"	Z-2	"
22.	"	"	"	"	"	"	"	"
23.	B-4	"	"	"	Z-4	Z-2	"	"
24.	"	"	B-7	Z-4	"	"	Z-1	B-1
25.	"	B-1	"	"	"	"	"	"
26.	"	"	"	"	"	"	R-5	"
27.	"	"	"	"	"	B-3	"	"
28.	"	"	R-5	"	"	"	"	"
29.	"	"	"	Z-6				
30.	"	"	"	"				
31.	B-2	R-1	B-7	"				

Zone	MAR I	MAR II	MAR III	MAR IV	APR I	APR II	APR III	APR IV
1.	B-7	B-3	Z-3	B-1	R-6	B-1	B-5	Z-5
2.	"	"	"	"	B-3	"	"	"
3.	"	Z-2	"	"	"	"	"	Z-4
4.	"	"	"	B-2	"	"	"	"
5.	"	"	Z-1	Z-2	"	Z-2	B-4	"
6.	B-5	"	"	"	"	"	"	"
7.	"	"	"	"	B-4	B-1	"	"
8.	"	Z-1	B-7	Z-6	"	"	"	"
9.	"	"	"	"	"	"	"	Z-2
10.	Z-4	Z-2	"	"	"	R-1	"	"
11.	"	"	B-6	Z-2	"	"	R-4	R-2
12.	"	"	"	"	"	"	"	"
13.	"	"	Z-3	"	"	"	R-5	Z-2
14.	R-4	"	"	"	Z-2	"	"	"
15.	"	B-3	"	"	"	Z-1	B-5	B-3
16.	"	"	"	Z-1	"	"	Z-3	"
17.	"	"	Z-2	"	R-1	R-1	"	"
18.	"	"	"	R-2	"	"	"	"
19.	B-3	"	"	"	"	R-2	B-7	"
20.	"	"	"	"	Z-1	"	"	"
21.	"	"	"	R-4	"	Z-3	Z-3	"
22.	"	B-1	B-5	"	"	"	"	"
23.	"	"	"	"	R-5	Z-2	"	"
24.	B-5	"	"	"	"	"	B-2	"
25.	"	R-5	B-6	"	"	B-3	"	"
26.	"	"	"	Z-5	"	"	"	B-1
27.	"	"	"	"	"	"	"	"
28.	"	"	"	"	"	Z-2	"	"
29.	B-[illegible]	Z-1	B-5	"	Z-1	"	"	"
30.	"	"	"	"	"	"	"	"
31.	R-6	"	"	"				